Tampereen yliopisto

Olli-Pekka Peitsalo

BUSINESS MODEL DEVELOPMENT UNDER TECHNOLOGICAL DISRUPTION: A CASE FOR THE INTERNET OF THINGS

Department of Industrial Engineering and Management
Master of Science Thesis
August 2019

ABSTRACT

Olli-Pekka Peitsalo: Business model development under technological disruption: a case for the Internet of Things
Master of Science Thesis
Tampere University
Industrial Engineering and Management
August 2019

Disruptive innovations force forward-looking companies to rethink their business models as market demands rapidly change, while conservative companies struggle to cope. Internet of Things poses as the next disruptive innovation that is about to change business moving forward and thus offers an interesting avenue for research. This Master's thesis aims to examine the ways how business models can be constructed during this period of technological emergence, while illustrating the potential pitfalls and challenges related.

The findings of this study are based on a literature review, a set of interviews and a conducted survey that was sent to the distribution chain of a single Finnish company. Data, used in the study, was gathered from 2018 to 2019 utilizing scientific databases Web of Science and Scopus. Due to the contextual nature of the study, findings are highly specific to the case company and generalization of the results may be limited. However, findings from the literature review and interviews may be more applicable and may serve as a basis to evaluate current development in the field of Internet of Things (IoT) and how business models are developed for the era of emergence of IoT.

The concept of a business model is heavily tied with the strategy of a business, in that a pre-planned business model helps companies define which opportunities to take and understand what the requirements are for doing so. Business models help organizations recognize what kind of capabilities are required to execute value creating activities. In circumstances of technological emergence companies may find themselves unable to develop the required capabilities inhouse and thus, are required to look for them elsewhere. One of the key takeaways of the study was that firms approach IoT with strict goals in increasing their topline and profitability. However, this might be difficult due to lacking capabilities or due to mismatched expectations.

Keywords: IoT, business models, value creation, value capture, innovation ecosystem

TIIVISTELMÄ

Olli-Pekka Peitsalo: Liiketoimintamallien kehitys teknologisen murroksen aikana: tapauksena Esineiden Internet
Diplomityö
Tampereen yliopisto
Tuotantotalous
Elokuu 2019

Disruptiiviset innovaatiot ajavat edistykselliset yritykset uudelleen harkitsemaan liiketoimintamallejaan markkinatarpeiden kehittyessä entistä nopeammin, samalla kun konservatiivisemmat firmat löytävät hankaluuksia vauhdissa pysymisessä. Esineiden Internet näyttäytyy seuraavana suurena disruptiivisena innovaationa, joka tulee muuttamaan liiketoimintaa valtavasti tulevaisuudessa ja siksi tarjoaa mielenkiintoisen tutkimuksen kohteen. Tämän diplomityön tarkoituksena on tarkastella tapoja, kuinka liiketoimintamalleja voidaan rakentaa teknologisen murroksen aikana, tarkastellen myös mahdollisia esteitä ja haasteita mitä näihin liittyy.

Diplomityön löydökset perustuvat kirjallisuustutkimukseen, haastatteluihin sekä kyselyyn, joka lähetettiin erään suomalaisen yrityksen jakeluverkolle. Tutkimuksen lähteinä käytettiin tieteellisiä tietokantoja (tarkemmin Web of Science ja Scopus) ja dataa kerättiin vuoden 2018 ja 2019 aikana. Johtuen tutkimuksen kontekstisidonnaisuudesta tutkimuksen löydökset voidaan nähdä erittäin spesifisinä tapausyritykselle, joka rajoittaa tulosten yleistämistä. Tutkimuksen kirjallisuuskatsaus ja haastattelut voidaan kuitenkin nähdä yleistettävimpinä ja näin ollen voivat toimia pohjana Esineiden Internetin ja tähän liittyvien liiketoimintamallien kehityksen arviointiperustana.

Liiketoimintamallin konsepti on hyvin sidonnainen yrityksen strategiaan, sillä hyvin suunnitellut liiketoimintamallit luovat raamit sille, että yritys kykenee arvioimaan mitä mahdollisuuksia ajaa takaa ja ymmärtämään mahdollisia vaatimuksia mitä kukin liiketoiminnan mahdollisuus pitää sisällään. Liiketoimintamallit auttavat yrityksiä tunnistamaan tarvittavia kyvykkyyksiä arvontuotantoon. Perustuen työn tuloksiin, yritykset usein lähestyvät Esineiden Internetiä saavuttaakseen korkeamman kannattavuuden tai kasvattaakseen liikevaihtoaan. Tämä voi kuitenkin osoittautua hankalaksi, johtuen rajallisista kyvykkyyksistä ja yhteensopimattomista tavoitteista.

Avainsanat: IoT, liiketoimintamalli, arvon luonti, arvon lunastus, ekosysteemi

PREFACE

Roughly a year since I first began collecting materials for this thesis, this arduous journey comes to a close. I would like to thank the case company for providing an opportunity to work on this thesis and for the support along the way to ensure this thesis would eventually come to a complete. I would like to thank all of the personnel of the case company and researchers from VTT who have challenged my views and commented on the topics discussed in the thesis along the way and have helped me clarify my work process.

I would also like to thank the examiner for my thesis, Saku Mäkinen, for your help along the way. Finally, I would also like to thank my friends and family who helped me through the ups and downs that was the writing process of this thesis.

Espoo, 20.10.2019

Olli-Pekka Peitsalo

CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

Established businesses operate under a business model, regardless of industry or product. This business model, either explicitly or implicitly, explains the design of value creation, delivery and capture that the business employs (Teece, 2010). The basic fundamental of the business model is to find and define the manner in which the business delivers this value to customers and how it aims to incentivize the customers to pay for the value offered, and eventually transforming value into profit.

Traditionally, the notation of a business model relied upon an idea of a value chain, in which the focal company is positioned along the chain, adding value to inputs, and then passing the outputs further downstream in the chain (Porter, 1985). In essence, this meant that the value had been embedded in the goods produced. During the past decade, however, academic discussion has moved away from a goods-dominant thinking into a new business logic where the emphasis is on the customers' active role in value creation (Ojasalo and Ojasalo, 2018).

The modern interpretation of the business model, that incorporates elements such as ecosystems, where a business is a part of a larger collective, became more prevalent with the advent of the Internet in the mid-1990s and has gained more interest from researchers and practitioners alike since (Zott, Amit and Massa, 2010). From a research perspective, this portrays a challenge, as the business model as a concept still lacks a commonly agreed upon definition (Zott, Amit and Massa, 2010; Wirtz *et al.*, 2016; Chesbrough, Lettl and Ritter, 2018). Since the 1990s, technological development has accelerated significantly, causing traditional business models to lag behind.

1.1 Background and motivation for research

The Internet of Things (IoT) refers to the interconnection of physical objects, where objects are equipped with sensors, actuators and a connection to the internet (Dijkman *et al.*, 2015). Technologies with IoT capabilities have a goal of developing new applications and to improve existing applications. Some famous examples of IoT applications

include personal health monitoring devices such as wearables or farming applications that adapt to the conditions of the day.

Currently, the area of IoT has experienced explosive growth, where the number of connected ‘things’ has increased threefold over the past five years (Digitimes, 2013, in Dijkman *et al.*, 2015). This development offers businesses in different industries significant business opportunities previously not available. Organizations around the globe expect IoT to become an important source of revenue, where its “productization” will be a significant driver for potential financial returns. For a business to be successful in taking advantage of this growth in the field of IoT, it must align its strategy accordingly.

A business model aims to conceptualize a business strategy and its components, as it aims to answer, e.g., “Who does the business sell its goods to?”, “What kind of activities are involved in creating said goods?” and “How does all of this turn in to generating a profit?”. However, academic research into business models has been extremely fragmented, with several interpretations of what the concept is, and what the impact of it is to the business’s performance. Zott, Amit and Massa, 2010 explain that at a general level the business model has been called as *a statement* (Stewart & Zhao, 2000)*, a description* (Applegate, 2000)*, a representation* (Morris, Schindehutte and Allen, 2005)*, an architecture* (Osterwalder and Pigneur, 2002)*, a conceptual tool or model* (Osterwalder, 2004)*, a structural template* (Amit & Zott, 2001)*, a method* (Afuah & Tucci, 2001)*, a framework* (Afuah, 2004)*, a pattern* (Brousseau & Penard, 2006) and as *a set* (Seelos & Mair, 2007).

Combining the factors of a contested conception of a business model, its included components, and the huge potential in IoT solutions, the main subject of this paper is going to be how a business model should be formed around commercializing IoT solutions and on what kind of affects this would have on the contents of an established business model. The capabilities required for bringing more complex IoT solutions to the market are also considered as a key part of this study, as they often force manufacturers to deepen their existing relationships in capability development or to operate with newer partners or to leverage existing capabilities elsewhere.

This study is conducted on request from a larger-sized Finnish enterprise, that is currently considering many of the topics described above. The study took place from Autumn 2018 till Spring 2019, during which the researcher had a supportive role in the

enterprise and was involved in operations closely related to the topic of the study. However, to an extent, the results of the study should be applicable in a more general context of business model development in IoT development'

1.2 Research questions and objectives

The focus of the paper is to identify which elements of a business model see an increase in importance through the disruptive development that is the adaption of Internet of Things. As Internet of Things solutions often allow for more novel value creation ideas to manufacturers and enable new and different ways for establishing revenue streams. Conversely, this puts emphasis on capabilities previously not required, as an example in Information and Communications Technologies (ICT). Historically, ICT has offered increased efficiency and effectiveness in product development and has contributed in the development of new product-service systems (Luz Martín-Peña, Díaz-Garrido and Sánchez-López, 2018).

This study aims to detail how established business models undergo changes as the adaption of the IoT becomes more widespread. Additionally, this study attempts to understand what elements of established business models raise in significance concurrently with IoT development. One of the key elements of the study is to link business performance, where barriers and opportunities may be, with the concept of an ecosystem that surrounds the enterprise. More specifically, a question is raised on how the distribution of the business affects the potential for business model development.

The development in IoT offers companies unique opportunities to amass knowledge on how their customers are using their products, allowing companies to move closer to their customers (Rymaszewska, Helo and Gunasekaran, 2017). This often allows companies to tailor their offerings closer to customer needs, answering a demand the customer may not have yet realized. Partly for this reason, the introduction of Internet of Things solutions to the market has been notably based on a technology push strategy, rather than a market pull strategy (Allmendinger and Lombreglia, 2005). During the past couple decades, even without the introduction of IoT solutions, companies have moved closer to their customers, through vertical integration and through customer-centric design (Wise and Baumgartner, 1999). Distribution, being close to the customer, offers an interesting avenue for research.

The objective of the paper is to combine considerations of business model development in the landscape of widespread IoT adoption to how the customer facing side of

the business, in this case the distribution, enables and limits the company and to study how business model development takes place in a system like this. Currently there is relatively little research done on business models of the IoT era, however, with growing attention in business model research and the acceleration in technological development, the topic seems appropriate for a deeper dive. Furthermore, the purpose of the study is to provide a suitable action plan for companies building their business models of the future that further consider the ecosystems that surround them. To grasp this objective, three research questions (RQs) are brought up:

RQ1: How can companies develop business models suitable for change caused by the advent of Internet of Things?

RQ2: What elements of the business model raise in significance when bringing Internet of Things solutions to the market?

RQ3: How can companies identify external capabilities that affect business model development through a fundamental change, such as the advent of Internet of Things?

First, the study aims to raise the question on how business models should be constructed for the age of widespread Internet of Things adoption. This question is considered by establishing what a business model is, what the components of a business model are and then considering how these components differ in traditional manufacturing in comparison to the field of IoT solutions. As previously mentioned, areas regarding ICT may be unfamiliar to companies operating under the traditional value chain perspective. Furthermore, novel IoT solutions may operate under the same underlying company conditions in some respects and differ widely in others. Providing thought into what the differentiating factors are is one of the key areas of the study.

Even with more novel solutions, the basic structure of a business model may remain identical to what it previously was, however, there may be a change in emphasis from an area to another. In a world view where data itself becomes valuable, capitalizing on said value may provide different solutions to different industries. To some, it may offer a chance of restructuring maintenance, in favour of pre-emptive maintenance (as opposed to on-call maintenance), offering customers increased uptime on the long run (Heppelmann and Porter, 2015). As an example, in this case, the core activity of main-

taining products after purchase persists, however, in a widely different manner. The second research question aims to provide a perspective into how examples, like the one previously made, manifest through changes.

Finally, the third research question of the study aims to delve deeper how external capabilities should be considered in business model development. When opportunities are realized further downstream, and with the focus on knowing the customer's activities, further emphasis is likely put on to the customer facing entities of the ecosystem. The role of distribution in this case may offer unique opportunities for novel partnership structures or may pose barriers for effective value capture. Additionally, there should be consideration into how distribution for IoT solutions should be considered in its entirety. Understanding what the distributors' capabilities are, may offer interesting avenues for value delivery to customers or, conversely, may pose threats to the manufacturer's business in distributors capturing business previously owned by the manufacturer. This study conducts a concept exploration into what capabilities are and tries to create an understanding on how the set of capabilities present should be considered for business model development moving forward. Concepts of capabilities range from operational capabilities to dynamic capabilities, while including many others, thus, making sense of the distinction between different concepts is one of the key areas of study.

1.3 Research structure and thesis outline

This thesis is divided into six chapters, which are, in order, introduction, theoretical background, explanation on how the research was conducted, illustration of empirical results, discussion on the empirical results found and finally, conclusions. The introduction chapter of the thesis provides the reader an idea of what the background for the study is going to be, what the objectives of the paper are and what the structure of the thesis will be. The study's research questions are also outlined in the introduction chapter.

In the theoretical background chapter of the thesis, the theoretical foundation for the study is built, as the chapter aims to explain the different types of capabilities there are and their relation to the business model concept. For one, the distinction between different types of capabilities is given in the chapter. Additionally, business models are explained on a conceptual level in this chapter. Fairly recent development into what constitutes a business model is detailed and finally an idea of the modern interpretation of the business model canvas is given. Following the discussion around business models, an

elaboration on ecosystems, and more specifically, innovation ecosystems is given. With IoT solutions, the interconnectivity of the company to its ecosystem becomes even more apparent and the idea of this is elaborated upon during the final parts of the chapter.

The third chapter, titled “Conducting the research”, describes how the research took place. The chapter includes an elaboration on the research methodology that was used in the study and evaluates the chosen methodology further. Thoughts on how the goals of the study would be achieved are elaborated on and the methods of data collection are described. Additionally, the methods of analysis are expanded upon in this chapter and some of the potential pitfalls of the study are considered in further detail. In this thesis, data will be collected through a literature review, through semi-structured interviews and through a survey. This means that the data collection in the thesis incorporates both qualitative and quantitative methods.

In the fourth chapter of the study, the empirical results are illustrated. This chapter includes both, results from the interviews, and results from the survey, as they offer interesting avenues for considering the topic at hand. Structurally, the interview results are used to verify ideas brought up in the literature review, whereas the survey results open avenues for new areas for consideration in terms of business model design. Furthermore, some comparatives are drawn in this chapter, as some of the topics discovered have been discussed prior to this chapter. These comparatives are used to reflect upon previous discussions opened in the study.

The fifth chapter offers a critical discussion of the results presented in the fourth chapter. Linkages between the academic consensus and the real-world issues found are also drawn. To an extent, this chapter provides a bridge between what the next steps for a business moving forward should be and how all of the findings reflect upon the literature review. An action plan for business model development is drafted, based on the results, while reflecting upon the literature review.

Finally, the sixth chapter concludes this study, by illustrating the key findings of the thesis. Relations to the research questions in the introductory chapter are drawn and some possible areas of further research are identified. Considerations are made on what the limitations of the study are and some final thoughts on the topic are given.

2. THEORETICAL BACKGROUND

This chapter explains the theoretical background, on which the study is built upon. The chapter is divided into smaller subchapter each considering a theoretical area that is focused on, first of these subchapters regarding capabilities and digitalization and the link between these two areas. The second subchapter focuses on business models, on how they came to be and what kind of frameworks have been historically studied in academic research. The third subchapter considers innovation ecosystems and how they are often formed. The final subchapter aims to synthesize the theoretical background by providing a view into business models in the age of internet of things and by summarizing previous topics to provide a comprehensive look into the field of study considered.

2.1 Capabilities and digitalization strategy

In the first subchapter the concepts of capabilities and digitalization are discussed and analysed in depth. To provide a comprehensive look at the subject, different definitions for capabilities are drawn and categorized by type. To extend this analysis, definitions from different authors are illustrated and explained in detail, allowing the reader to further understand the significance of each structure. Reflecting upon the resource-based view (RBV), also explained in the subchapter, a view into dynamic capabilities is given. Based on academic research, organizations that go through evolution after evolution find competitive advantage through successful utilization of dynamic capabilities at their disposal. This contrasts the resource-based view in that one of the core tenets of RBV is the development of sustainable competitive advantage. Thus, the subchapter aims to take a look into areas where these two management philosophies are alike and where they differ. The subchapter concludes by explaining the capability lifecycle, a model that illustrates that capabilities do not exist in a vacuum but are exposed to changes through development.

2.1.1 Capabilities and sustainable competitive advantage

In this study, the area of capabilities and their relation to organizational performance is based on the works of David Teece (e.g. 1998; 2010) in dynamic capabilities, Henry Chesbrough (e.g. 2002; 2010) on open innovation and on the work of Jay Barney on the resource-based view and his perspective on how a company can find sustainable competitive advantage (e.g. 1991). Barney (1991) elaborated upon the link between the firm's resources and sustainable competitive advantage by basing his view on the assumption that strategic resources would be heterogeneously distributed across firms within a market and that the differences between companies would be rather stable over time. Barney (1991) argued that, at the time, most of the research focused on either isolating firm's opportunities and threats (e.g. Porter with the Five Forces model), describing the firm's strengths and weaknesses (e.g. Penrose with the Theory of the Growth of the Firm) or on analysing how the firm's strengths and weaknesses are matched with the strategy chosen. Additionally, Barney (1991) elaborated that the focus, at the time, tended to shift more towards the external view of strategy in illustrating opportunities and threats that the company faces. With the resource-based view, Barney elaborated upon a concept where firms operate in an industry where strategic resources can be heterogeneous for an extended period of time.

The resource based view presented by Barney (1991) built upon an article titled "A Resource-Based View of the Firm", where sources of competitive advantages were presented by Wernerfelt (1984). Wernerfelt (1984) illustrated that the firm's resources are the fundamental basis for competitive advantage and form the basis for company's strategic analysis. Furthermore, Wernerfelt (1984) added that the control over resources often translated to an ability to sustain a superior profitability over a long term.

In his article, Barney (1991) listed the firm's resources to include all assets, *capabilities*, organizational processes, firm attributes, *information, knowledge*, etc. Narrowing down to the context of this study, the main focus is aimed towards capabilities and to a lesser extent towards information and knowledge, areas that are essential building blocks for revenue generation in the field of Internet of Things (e.g. Heppelmann and Porter, 2015; Leminen *et al.*, 2018). Within the resource-based view, a firm can find sustained competitive advantage when it implements a value creating strategy not simultaneously implemented by any current or potential competitors and at a time when its competitors are unable to copy the benefits of the chosen strategy. (Barney, 1991)

The resource-based view explains that the nature of competition is based upon a premise where competitors within a given market differ from each other in the way they use their resources and capabilities. RBV portrays this in a manner, where these differences are often durable, long lasting and are the major factor in differentiating competitors. These differences then lead different firms finding competitive advantage and/or disadvantage within the target market. The basis of the resource-based view is not necessarily static in its approach, but it can be inferred that the view provided by the resource-based theory is rather static. In their criticism, Priem and Butler (2001) explained that the resource-based view of strategy would require a more dynamic approach to be a more effective tool in illustrating competitive situations of the modern era. Helfat and Peteraf (2003) aimed to extend the previous understanding of the resource-based view into a more comprehensive theory that would address the dynamic nature of capabilities and competition by introducing a dynamic resource-based theory that would be based upon an understanding of the capability lifecycle. Combined with the increased academic interest in dynamic capabilities coined by Teece, Pisano and Shuen (1997), where dynamic capabilities involve adaption and change within organization's resources and capabilities, capabilities can be seen as a major driver within creating competitive advantage for an organization.

On the other hand, Spender (2014) argued that, as opposed to capabilities and resources, the knowledge the company possesses should be viewed as the basis of the dynamic resource-based view. This is based upon the idea that corporate strategy theorists have been paying greater attention to the idea of the firm as a body of knowledge (e.g. Grant, 1996). Grant (1996) noted that, at the time, disruptive market conditions stemming from rapid innovation, have resulted in organizational capabilities rearing their head as the foundational point in setting long-term strategies. However, Grant (1996) also noted that, should knowledge be the most important resource of the firm, organizational capabilities should reflect this in organizational capabilities being the driver in integrating knowledge to an organizational level. Thus, in this view, knowledge acts as a precursor to the creation of capabilities within the organization.

Academic literature has explored the role of organizations in knowledge acquisition, processing and application, offering a possible avenue of application to the previously mentioned way to integrate knowledge via the use of organizational capabilities. To illustrate the logic in a simplified manner, figure 1 can be observed where the approach to knowledge within an organization is drafted.

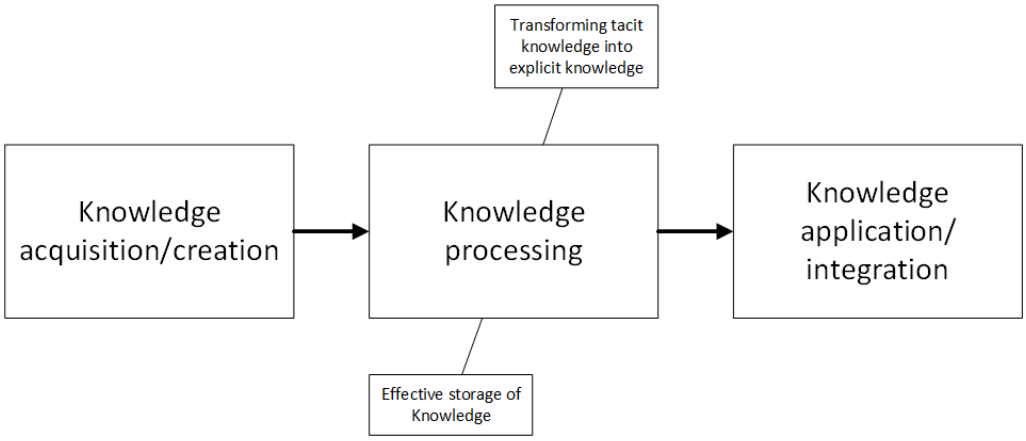


Figure 1 *Knowledge within an organization.*

In the illustration above, knowledge acquired by the organization via acquisition or creation. This, in effect, means that the organization either purchases the knowledge by e.g. hiring or creates said knowledge by e.g. organizational learning. Knowledge within the organization is processed in a way, that it can be usable in creating competitive advantage, by transforming the knowledge from its tacit form into an explicit form. Grant (1996) noted, that this conversion of tacit knowledge, knowledge that is tied to individuals, into explicit knowledge via the form of rules, directives, formulae, expert systems etc. results inevitably in knowledge loss. This, combined with similar issues found in knowledge storage, often result in situations where it is extremely difficult for an organization to transform knowledge into competitive advantage. Grant (1996) identified that there are three major contributing factors that drive the formation of competitive advantage from knowledge integration, in order; the efficiency of integration, the scope of integration and the flexibility of integration, illustrated below in figure 2.

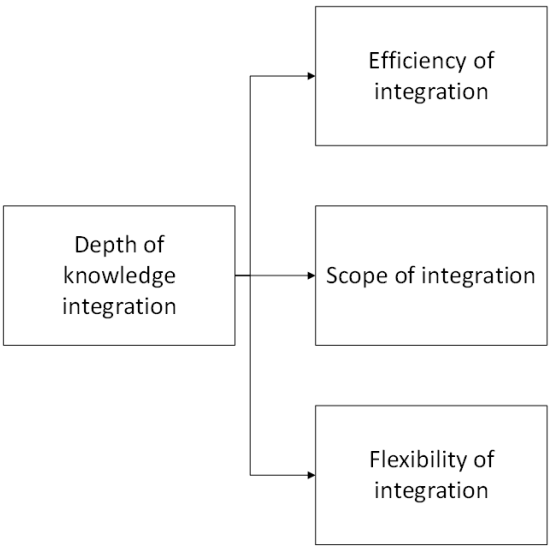


Figure 2 *Integration of knowledge within an organization.*

Efficiency of Integration explains the extent to which a capability can access and utilize specialist knowledge held by individuals in an organization. The scope of integration explains the depth to which the capability is capable of drawing existing knowledge in the firm. Finally, the flexibility of integration illustrates how the capability can access the knowledge and reconfigure it to match the organization's needs.

To drive forward the significance of knowledge within an organization, Valtakoski (2017) illustrated that knowledge-based perspectives have made it possible for modern organizations to move towards servitization strategies that offer closer integrations to the customers. Valtakoski (2017) adds that prior literature has identified servitization strategies that transition manufacturing firms from being product-centric towards comprehensive integrated solutions combining products and services. These strategies' range from fairly simple maintenance plans to highly knowledge-intensive services. Wise and Baumgartner (1999) explained that manufacturers were moving downstream and basing their offerings increasingly in service offerings, in order to create competitive advantage, to create stability in revenue streams, to increase profitability and to improve customer satisfaction. For manufacturers to capture the full benefits offered by these types of offerings, a wide range of services supporting sold products are often introduced (Mathieu 2001, in Raddats, Burton and Ashman, 2015).

In the resource-based view, Barney (1991) mentions that knowledge is often valuable, rare and hard to imitate and therefore an important source for competitive advantage.

However, to support the full utilization of knowledge within organizations, a comprehensive set of capabilities has to be employed. Capabilities required often extend beyond the organization to its surrounding ecosystem, where, for example, providers of integrated solutions are highly dependent on the specialized skills and capabilities of their suppliers (Finne and Holmström, 2013).

Additionally, the firm's capabilities can have a positive impact on the firm's success, by for example increasing the firm's financial performance, by providing competitive advantage and by increasing customer loyalty. However, it should be mentioned that when success is measured, views based on solely the financial measures often lead to a narrow view on firm performance and, therefore, a measurement of performance should be more comprehensive and multi-faceted. Additionally, it is often problematic to measure financial performance statistics on a specific level, e.g. service-specific level, as many manufacturers measure financial indicators on a more overall level, where products are often combined with related services and direct links between, for example services and products, are hard to draw upon. (Raddats, Burton and Ashman, 2015)

On the contrary to the resource based view, studying Porter's (1980) generic competitive strategies would lead to a conclusion where competitive advantage is drawn from effective positioning of the firm's offering. These generic strategies include cost leadership, differentiation and focus. In differentiation and focus strategies, firms aim to offer customers added value, whereas cost leadership aims to lower costs. For example, in differentiation, through offering unique relative value to a consumer base the firm can capture markets with the value components offered. However, in his article titled "How Information gives you competitive advantage", Porter (1985) emphasised how information, a type of knowledge, has affected the competitive scope and the way companies offer value to customers. Thus, information could be interpreted as being helpful in positioning the firm's offering. Extending this thought, a conclusion can be drafted that, therefore, information could lead to a competitively advantageous position through capability nurturing or through efforts of positioning the firm's offering.

Similarly, other authors, namely Winter (2003) and Teece, Pisano and Shuen (1997), by extending the resource-based view, would arrive to a conclusion where competitive advantage could be found through the effective use of dynamic capabilities. These capabilities help to extend, modify or create ordinary capabilities. Contrary to the previously mentioned frameworks, dynamic capabilities are used to adapt to changing market conditions or in better tailoring of the firm's offering to a customer base that the firm is after.

Simplifying summarization could be drawn, where an organization operates with a knowledge base, that is then internally processed with the use of capabilities. Whether it is capabilities used in developing new offerings for consumers, or whether it is organizational capabilities to better fit the organization's efforts to suit its strategies, or whether it is capabilities in choosing how to position the company's offering, capabilities are used as a tool in achieving any previously mentioned goal. Thus, the aim of these capabilities is then to find sustainable competitive advantage within the market. It should be noted, that this is an overly simplified notation and should be taken as such. To illustrate this simplification a figure 3 is drawn.

Figure 3 *Simplification of the link between knowledge and competitive advantage*

2.1.2 Capability types

The overarching concept of a capability can be seen as a broad one, ranging from different specific types of capabilities to a more foundational level, in which capabilities generate different types of 'ordinary' capabilities. Therefore, it is important to understand what the range of capability types is researched within this study. The importance of effective and efficient capability usage could be observed within the resource-based view, that looked at capabilities as a vital part in building competitive advantage to the firm (Barney, 1991). Linking capabilities to corporate performance has received a great deal of research starting from the 1980s all the way to current day (e.g. Johnston and Carrico, 1988; Leonard-Barton, 1992; Teece, Pisano and Shuen, 1997; Christensen, Verlinden and Westerman, 2002; Helfat and Peteraf, 2003; Paiola *et al.*, 2013; Helfat and Raubitschek, 2018). In the context of this study, a special interest is in how capabilities are measured and developed during disruptive market conditions.

To understand the landscape of different types of capabilities, one should first elaborate upon the different schools of thought when it comes to capability management and

how capabilities are understood. One of the simpler differentiations that can be drawn between different types of capabilities, is the distinction between internal and external capabilities, condensely, illustrated below in figure 4.

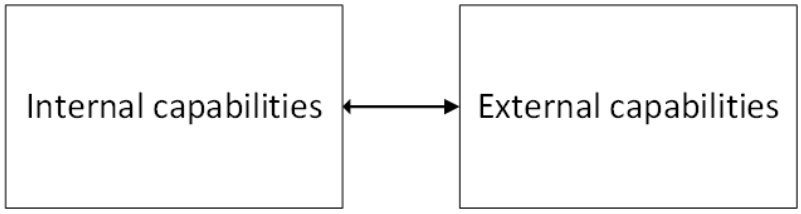


Figure 4 *Internal and external capabilities.*

The differentiation between internal and external capabilities can offer strategic planners a good perspective in making strategic decisions, as for example, in manufacturing planners can consider core competences, presented by Prahalad and Hamel's (1990), of the organization. Christensen (2002) explained that the development of internal capabilities allowed firms to perform a set of activities inhouse within an organization. Additionally, this perspective offered insight when to outsource certain elements of the value proposition to external players. Furthermore, this would then indicate that the presence of internal or external capabilities would be a driving factor for strategic 'Make-or-buy' decisions. The strategic question of 'make-or-buy' far exceeds the recent studies conducted in linking capabilities and corporate performance, going all the way back to Ronald Coase's (1937) question whether production should be organized interfirm or whether through the market the organization operates in (in Tadelis, 2001). Adding to this narrative, in a more recent study, Paiola et al. (2013) added that manufacturers moving from offering products to solutions often resulted in a strategic choice whether necessary capabilities should be developed internally or externally. However, an organization may also choose a mixed approach where capabilities are developed both internally and externally to fit the strategic approach of the company. Davies (2004) conceptualizes the landscape of firms that undergo these development efforts, by introducing concepts like the "system seller", that focuses on developing internal capabilities and the "system integrator", that focuses on the integration of externally developed capabilities to those developed internally (in Paiola *et al.*, 2013).

In their article, Prahalad and Hamel (1990) argued that for an organization to find competitive advantage within a given market, an organization has to focus on the core competencies of the firm. These can be identified as the competencies that, first, give

potential access to a wide variety of markets, second, make a significant contribution to the perceived customer benefit, and lastly, are difficult for competitors to imitate. Additionally, Prahalad and Hamel (1990) argued that activities that are not part of the organization's core competencies, should be outsourced. Brought to the context of internal and external capabilities, this would indicate that the firm should focus on the internal capabilities that can be perceived as core competences by nurturing and developing those capabilities. Conversely, by that extent the firm should also utilize external capabilities to provide for value creating activities that are not part of the firm's core competences. Following this logic, finding a balance between the utilization of external capabilities and the efforts in developing internal capabilities could lead to an optimal competitive position for an organization.

Similarly, to the distinction between internal and external capabilities, the differentiation of capabilities can be drawn between dynamic capabilities and ordinary capabilities and this should be explored further. The separation of capabilities between dynamic and ordinary capabilities is not diametrically different to the distinction between internal and external capabilities. Conversely, the definition of dynamic capabilities often considers the nature of capabilities, rather than what entity eventually utilizes them. Teece, Pisano and Shuen (1997) defined dynamic capabilities as the extent to which an organization is capable of exploiting existing internal and external firm-specific competences to address the changing competitive environment. Additionally, this means that these firm-specific capabilities are used as a source of competitive advantage and that the dynamic capabilities are used to explain the combination of competences and the resources to be developed, deployed and protected by the organization. Tautologically, Teece, Pisano and Shuen (1997) specify dynamic capabilities as an ability for the firm to understand newer sources of competitive advantage and as the ability to emerge with strategies best suited for any given market condition. Distinctively, Teece, Pisano and Shuen (1997) emphasize that the word 'dynamic' in their article refers to situation where rapid change occurs in the market due to technological advances, market forces and/or 'feedback' effects. Therefore, dynamic capabilities include the competences and capabilities the organization possesses to adapt to the current market conditions. This can be achieved by adapting, integrating, and reconfiguring internal and external competences to fit the changing environment of the firm (Teece, Pisano and Shuen, 1997).

Teece (1998) added, that many sectors in the modern global market require the usage of dynamic capabilities, and that paradoxically, it is quite easy to define what dynamic capabilities are once they are present, but it is extremely difficult to explain how dynamic

capabilities are built within an organization. Teece (1998) explains that the efficient use of dynamic capabilities often occurs in two stages, where an organization utilizes dynamic capabilities to externally sense the opportunities for change and where the organization uses dynamic capabilities to move to a market direction based on external sensing. Teece (1998) argued further that sensemaking is a critical function of the firm, due to when it is well performed it will enable the organization to connect with its environment and to invest the resources the company has more reasonably, generating superior returns in comparison to competitors. The issue with sensemaking, however, lies in the fact, that it is impossible to have all the available and non-available knowledge there is about the situation at hand. Therefore, the action that follows sensemaking has to be based, at least to some extent, to hunches and informed guesses about the state of the situation. This means that when a timely opportunity is sensed, an organization must find a way to seize the opportunity by utilizing organizational action (Teece, 1998). Organizational action, in this case, refers to contracting the required external resources to the firm and to directing relevant internal resources to adjust accordingly. Borch and Madsen (2007) argue that dynamic capabilities are accentuated in small- and medium-sized enterprises (SMEs) as they can often be more agile when compared to their larger counterparts. Furthermore, Borsch and Madsen (2007) found that dynamic capabilities and innovative strategies were often linked, resulting in SMEs often finding success through flexibility for future strategies. Teece (1998), however, added that effective dynamic capability use is not restricted to only small companies, even if smaller companies appeared to excel within their environments through the use of dynamic capabilities. Summarizing how dynamic capabilities often provide competitive advantage, figure 5 is drafted.

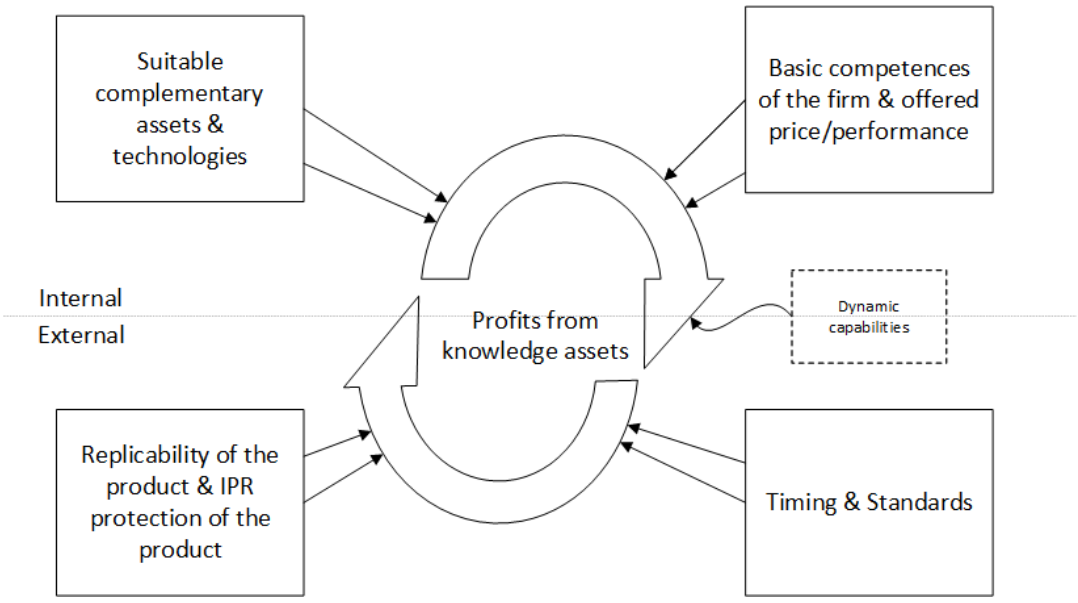


Figure 5 *Dynamic capabilities and profiting from knowledge assets, adapted from Teece, 1998.*

Dynamic capabilities include the ability to sense and then seize new opportunities, the capability to reconfigure and protect knowledge assets, competences, complementary assets and technologies and utilize all of these steps in creating competitive advantage within the firm's market.

Interestingly, Eisenhardt and Martin (2000) argued that dynamic capabilities also vary depending on the market dynamism that the market environment is going through. In moderately dynamic markets, Eisenhardt and Martin (2000) elaborate that dynamic capabilities resemble the traditional concept of routines, where they are stable, detailed and analytical processes with predictable outcomes. Conversely, in highly dynamic markets dynamic capabilities become more experimental with unpredictable outcomes. Contrastingly to prior mentions of dynamic capabilities in this study, Eisenhardt and Martin (2000) find that dynamic capabilities can be duplicated across firms, resulting in a functionality where the resulting resource configurations are achieved through the use of dynamic capabilities and then manifested in the functional value that brings competitive advantage, as opposed to creating the capabilities that do so.

Dynamic capabilities, due to their nature, are often described rather vaguely, with concepts such as "capabilities to learn other capabilities". Thus, it is often difficult to pinpoint what is meant when the term of dynamic capability is used. However, for the context of this study dynamic capabilities can be understood as a range of activities ranging from

capabilities that integrate resources, reconfigure existing resources and/or gain and release resources within an organization. In their article, Helfat and Raubitschek (2018) argued that especially integrative capabilities play a significant role in the ability of the platform leader to capture value in a given market, thus, making integrative capabilities extremely vital in the modern ecosystem driven market.

Capability typology also includes lesser studied capability frameworks, that can come across often as similar to more established frameworks, such as the dynamic capabilities framework, or such as organizational capabilities, or capabilities regarding specific fields, such as marketing capabilities, IT capabilities and/or research and development capabilities. Early mentions of organizational capabilities picture these capabilities as complex by nature, where often a rapid change occurs in the environment, similar to the case of dynamic capabilities, or where a rapid change interfirm occurs, such as the company going international. Bartlett and Ghoshal (1987) referred to organizational capabilities as capabilities that enabled the firm to transform from having a unidimensional capability set to multidimensional one. At the time, challenges often rose from geographical expansion of the firm's operations, stemming from difficulties in business management and from functional management of the firm. To address issues in geographic management, firms used organizational capabilities to sense, analyse and respond to the needs of specific national markets. It becomes immediately apparent that the links to dynamic capabilities exist, as there are associations similarly to sensing, analysing and responding to market needs, however, in a less context specific way and in a broader sense. Business management had to address issues regarding product standardization and low-cost global sourcing, as the era was heavily characterized by outsourcing to lower cost countries. Simultaneously, through the utilization of functional management, Bartlett and Ghoshal (1987) explain that organizational capabilities are used to allow the company to build and transfer its core competences according to prevailing conditions.

Grant (1996) extended this concept into a foundational theory of organization capability that was more fundamentally based upon the notion of knowledge and knowledge deployment. Grant (1996) explained that the essence of organizational capability lies on the integration of specialist knowledge on how to perform a single productive task and on the multiplication of said tasks to ensure the firm a set of repeatable productive tasks to create value through. Furthermore, Grant (1996) illustrated that organizational capabilities required that a knowledge base was formed interfirm, based on a number of individuals in an organization, to be able to answer to possible external challenges the firm might face. Similarly, in their article, Helfat and Peteraf (2003) identified organizational

capabilities as an ability for the organization to perform a coordinated set of tasks, utilizing organizational resources, for the purpose of achieving a wanted end result.

As the distinction of capabilities could be perceived through the differentiation between internal and external capabilities, through the differentiation between dynamic capabilities and their ordinary counterpart, a more specific type of capability typology, based in context-specific circumstances, can be considered. These context-specific capabilities include, for example, marketing capabilities (e.g. Möller and Anttila, 1979), information technology (IT) capabilities (e.g. Bhatt and Grover, 2005) and human resource capabilities (e.g. Kamoche, 1996). Möller and Anttila (1979) defined the concept of marketing capability as a complex combination of human resources or a set of assets, more specifically market assets and organizational assets of the firm. By the given definition, marketing capabilities are used to assess a company's position within its environment, through evaluating customer and competitor performance and through managing the firm's relationships to its customers, competitors and distributors. Similarly, Morgan, Slotegraaf and Vorhies (2009) defined marketing capabilities by their proposed three core tenets, first marketing capability concerning market-sensing capabilities in learning about customers, competitors and channel members to continuously make sense of the market and to act on the opportunities presented. Second, Morgan, Slotegraaf and Vorhies (2009) explained marketing capabilities to include specific CRM capabilities, where the firm is capable to create and manage close and strong customer relationships over time. Lastly, they concluded that marketing capabilities also consider brand management capabilities, through processes and activities that take place in the firm in developing, supporting and maintaining strong brands within a market.

In their article, Bhatt and Grover (2005) classify information technology (IT) capabilities through three dimensions. These are, in order, the IT infrastructure, IT business experience and the relationship infrastructure. Bhatt and Grover (2005) consider IT infrastructure as regards to the extent to which the firm's systems are compatible, modular, scalable, transparent and to what extent the systems use commonly agreed upon IT standards. Adding to this, the IT business experience follows in analysing how knowledgeable IT groups are about business strategy, about competitive priorities, about business policies, about business opportunities and how willing IT groups are to initiate change in the organization. Lastly, in this framework, relationship infrastructure regards the internal relationships between the IT department and the line management (Bhatt and Grover, 2005).

In his article, Kamoche (1996) defined human resource capabilities as the human resource policies and practices that are in place in the firm. Kamoche (1996) added that human resource capabilities are often linked to the strategic value that is realizable to the extent to which they are linked to the core competencies of the firm. Kamoche (1996) argued that HR systems often facilitate and/or inhibit the development and utilization of competencies in the organization, thus, affecting the competitive possibilities of the organization.

Capabilities can also be defined from a hierarchical perspective where different levels of capabilities are defined by their complexity. Following this example, moving up the hierarchy would indicate that a capability is more distant from the very foundational ‘zero level’. Winter (2003) argued, that to benefit from a hierarchical system, such as the proposed one, a convention of the ‘zero level’ had be established first. Winter (2003) elaborated that the ‘zero level’, in a case like this, would consist of capabilities exercised in a stationary process. More specifically, narrowing down to what could be affectionately called ‘how we earn a living now’-capabilities. Winter (2003) continued by explaining that capabilities that change the product, the production process, the scale or the markets served are not ‘zero level’. Hine et al. (2013) expanded on the idea of a capability hierarchy by explaining that higher-order capabilities often have the greatest impact on the strategy of the firm. However, due to their nature, higher-order capabilities rely heavily on the successful management of lower-order capabilities in order for the company to be successful. In their article, Hine et al. (2013) argued for a capability hierarchy system that spans across three capability levels that reflect four internal dimensions and one external dimension. The capability hierarchy adapted from the proposed model by Hine et al. (2013) can be found below in figure 6.

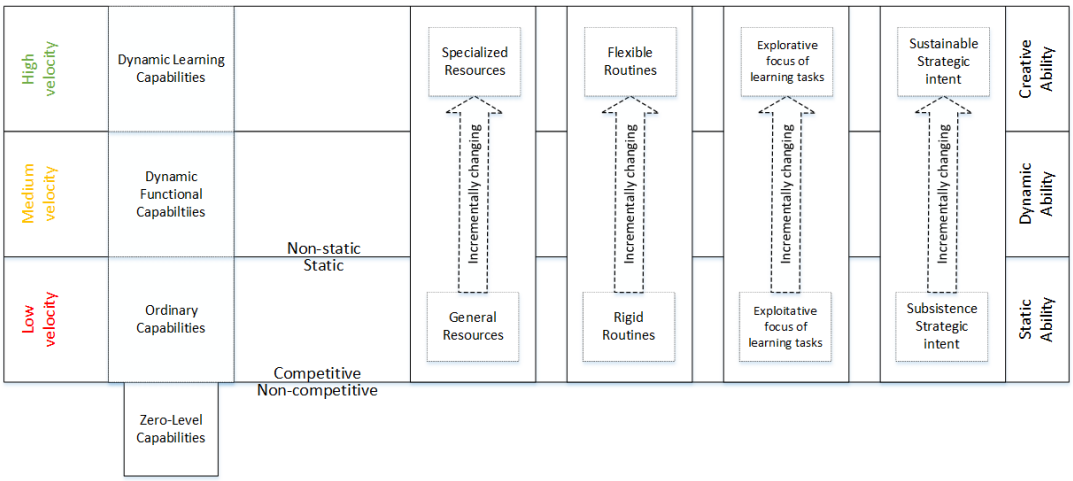


Figure 6 *Capability hierarchy, adapted from Hine et al., 2013.*

The notable additions Hine et al. (2013) proposed to the capability hierarchy are the distinctions between competitive and non-competitive capabilities and the distinctions between static and non-static capabilities. At the very foundational level, one can observe that the firm has 'zero-level' capabilities that Hine et al. (2013) define as non-competitive capabilities. These include systematic routines that take place within an organization that, however, are necessary, but cannot be considered competitive by their nature. Hine et al. (2013) explained that ordinary, static, capabilities focus on the day-to-day tasks of the firm meaning the tasks done with the company's current resources. These resources over time become a part of the 'zero-level' day-to-day routine and transform into 'zero-level' capabilities. Controversially to this view, Winter (2003) added that higher-level dynamic capabilities do not necessarily even exist in substantial way, as there is often no recognizable pattern when it comes to governing higher-level change within an organization. Therefore, the distinction can sometimes seem arbitrary, however, it is important to acknowledge that there are distinctive hierarchies to capabilities that are often driven by external factors such as market velocity. This, to an extent, supports Eisenhardt and Martin's (2000) notation of dynamic capabilities varying depending on the market dynamism that is currently taking place.

Summarizing this subchapter; capabilities can be divided into subgroups based on their relative position to the firm (e.g. Internal and external capabilities), or based on the nature of those capabilities (e.g. dynamic capabilities and ordinary capabilities), or by their importance to the firm's competitive position (e.g. core capabilities and non-core capabilities), or by the hierarchy of those capabilities (e.g. zero-level capabilities and

dynamic functional capabilities) or by the specific focus area of the capabilities (e.g. IT capabilities and marketing capabilities). This capability typology offers a vague conceptualization of capabilities, allowing distinctions between these definitions to be philosophical, and allowing these definitions to have significant overlap. However, in order to find a common reference set of capabilities, some of the key features of each approach are listed below in table 1.

Table 1 *Capability approaches according to different authors*

Author(s)	Year	Proposed capability approach
Möller & Anttila	1979	*Marketing Capabilities* consider the firms operational environment by sensing the market and by seizing on business opportunities when available.
Bartlett & Ghoshal	1987	*Organizational Capabilities* allow the firm to transform unidimensional, context-specific capabilities into multidimensional, context-avoid capabilities.
Prahalad & Hamel	1990	The firm should focus on developing the *core competences* of the firm and should outsource any and all non-core activities.
Kamoche	1996	*Human resource capabilities* allow the firm to utilize and develop competencies that it, as an entity, has in order to gain competitive advantage in the market.
Grant	1996	*Organizational capabilities* are fundamentally based upon the notion of the acquirement of knowledge and in deploying gathered knowledge in order to achieve competitive advantage.
Teece et al.	1997	*Dynamic capabilities* allow the firm to exploit existing internal and external firm-specific competences to address the firm's competitive environment.
Teece	1998	*Dynamic capabilities* allow the firm to sense and then seize new market opportunities, thus, allowing the company to reconfigure and protect knowledge assets, competences, complementary assets and technologies to find competitive advantage within a target market.
Eisenhardt & Martin	2000	*Dynamic capabilities* vary depending on the market dynamism that takes place; in moderately dynamic markets *dynamic capabilities* resemble routines with predictable outcomes and in highly dynamic markets *dynamic capabilities* become experimental with unpredictable outcomes.
Christensen et al.	2002	It is strategically important for the firm to develop its *internal capabilities* to perform certain activities inhouse and complementarily important to outsource activities where value can be added by external sources.
Winter	2003	For an effective differentiation of capabilities by hierarchy, one must ground the convention of a *zero-level capability.* Zero-level capabilities include capabilities that are defined by their stationary nature and capabilities, that are at the cornerstone of how the company gathers revenue from its customers.

Table 2 *Capability approaches according to different authors, continued*

Helfat & Peteraf	2003	*Organizational capabilities* illustrate the ability of the organization to perform a coordinated set of tasks, utilizing the organization's resources, for the purpose of achieving a wanted end result.
Bhatt & Grover	2005	The firm's *Information technology capabilities* concern three dimensions; the firm's IT infrastructure, IT business experience and the relationship infrastructure the firm has.
Morgan et al.	2009	*Marketing capabilities* consider the firm's market sensing capabilities, its CRM capabilities and brand management capabilities.
Hine et al.	2013	The *capability hierarchy* differentiates capabilities based on four internal dimensions and one external dimension. These internal dimensions being the nature of resources utilized, the nature of routines employed, the focus of learning tasks and their strategic intent. Additionally, the external dimension of the capability hierarchy is the competitive dynamism of the market.

As table 1 illustrates, there can be vastly different approaches to how capabilities are defined within academic research. This reflects the fact that capabilities are often left undefined and are considered without specific definition, they essential just are. Context-driven definitions of capabilities also include fairly philosophical differences to more broader frameworks, thus, often leading to similar eventual frameworks. Additionally, it should be noted that table 1 provides a fairly light delve into the vast field of capability research and should this study be more focused on the capability side of things, a significantly broader look at additional research would have been taken. The function of table 1 is to illustrate that even with a rather small sample set of studies, a significantly diverse set of definitions can be found for capabilities in academic research.

2.1.3 The Capability lifecycle

Originating from the observation Wernerfelt (1984) made, that products and resources are two sides of the same coin, a line of thought resulting in a concept of the capability lifecycle could be drawn. Products, due to for example market forces, technological disruption and incremental upgrades, are said to have a cyclical lifespan, where individual products follow a predetermined development path with a recognizable pattern, known as the product lifecycle. With Barney's (1991) notation that the firm's resources include, among other things, the capabilities at its disposal, one can arrive to a conclusion where capabilities must follow a capability lifecycle similar to a product lifecycle. Levinthal and

Myatt (2012) explained that many capabilities in an organization emerge, are refined and decay due to product market development, thus they can be seen as having a development cycle. Among other areas, capabilities may be used to support a sequence of products or multiple products concurrently (Helfat and Raubitschek, 2000). Therefore, a product lifecycle and the capability lifecycle do not correspond with each other one-to-one. Additionally, a lifecycle of a capability may extend to cover multiple product launches and multiple product lifecycles. Therefore, a capability lifecycle may be extended way beyond a typical product lifecycle. Similarly to a product, a capability can go through different transformations through its lifetime and can often be adapted to fit a certain market condition (Helfat and Raubitschek, 2000).

Helfat and Peteraf (2003) argue that the capability lifecycle depicts the evolution of an organizational capability that resides within a specific team. Capabilities, whether operational or dynamic always include two sorts of routines, these routines include routines to perform individual tasks and routines to coordinate those tasks. Additionally, Anand and Khanna (2000) illustrated that capabilities extend to the ecosystem of the firm, consisting of alliance capabilities, where learning effects allow capabilities to develop across firms.

The capability lifecycle spans over several stages during its lifetime, often following a technology S-curve of a product lifecycle. This type of a lifecycle starts from the founding stage, where in this specific case a new capability is formed. This is followed by the development phase, where the capability is built upon and where incremental advances are found. Following the technology S-curve, after an extended period of development, capabilities also reach their maturnity stage where Helfat and Peteraf (2003) argue the capability enters a branching stage where organizations determine whether to retire, retrench, renew, replicate, redeploy or recombine existing capabilities. This is illustrated below in figure 7.

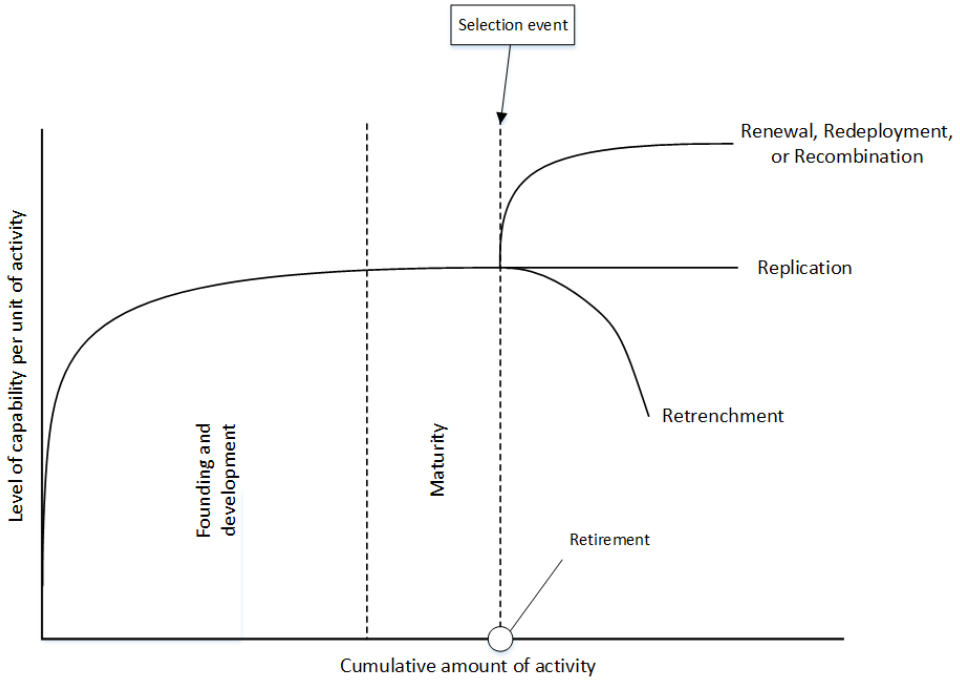


Figure 7 *Capability lifecycle, adapted from Helfat and Peteraf, 2003.*

It should be noted, that each of stages illustrated above in figure 7 could take a different form, as there might be diminishing returns from learning over time, thus, resulting in a curve that would more resemble the S-curve. However, in this study, the experience curve is used to describe the lifecycle to focus more on the selection event that occurs after the capability reaches maturity and to create a distinction to a traditional product lifecycle.

The founding stage in the lifecycle of a capability stems generally from two requirements. Explained by Helfat and Peteraf (2003), for a capability to be created, there must be an organized team or a group that is capable of joint action and is led by some type of leadership, and there must be a central objective, an objective that requires the creation of a new capability. The founding stage creates the basis on which the capability can be further developed, and thus, often shapes the direction in which the capability will be taken during its lifespan. Kale and Singh (2007) explain that organizations develop capabilities to get better at managing tasks, to learn from accumulated knowledge by making associations between the effectiveness of past actions and decisions of which future actions to take. This could be referred to as learning by doing, as accordance to Winter (2000). However, very few empirical studies have been conducted to confirm or refute

organizational learning taking place via the form of organizational capability development. In general, the basic path of capability development reflects upon the process of capability improvement within the firm.

At some point during its lifecycle, capability development stops, and the capability enters the maturity stage. This may be the result of the capability reaching the inherent limits to what any team could achieve with the technologies, inputs, workers, and the managerial practice it has at its disposal (Helfat and Peteraf, 2003). Winter (2000) argues, that at some point capabilities that are present reach a satisfactory point, where the team will perceive capabilities as acceptable and perceive that no further development is required. Winter (2000) adds that this may occur due to continuous episodes of relatively good performance and may be ended abruptly with the recurrence of difficulty. Additionally, Winter (2000) argues that capability's development peak lies much closer to what the participants try to accomplish rather than what it is possible to be accomplished. Maturity, in the case of capabilities, occurs when the capability becomes a routine, where the organization habitually replicates prior actions, instead of challenging prior conventions.

During its development stage or after its maturity stage (illustrated in figure 7) a capability reaches its branching stage where one the six 'R's' occurs through a selection event. The selection event often reflects a strategic goal the organization sets due to changing market conditions or due to organizational development. Helfat and Peteraf (2003) explain that the branches reflect the impact that the differing selection effects have, as part of the branches threaten to make the capability obsolete and others offer new opportunities to the capability via capability growth or change. This perception of capabilities as a construct, however, offers limited tools to organizations in the event of capability emergence. Levinthal and Myatt (2012) explained that what makes a capability or a resource valuable is often determined ex-post, meaning the determination of value for a capability is made after the organization has either succeeded or failed. By its design, the capability lifecycle model cannot address the practical steps an organization has to take to in order to capture valuable capabilities but offers a broad-level understanding on why certain organization had failed in their efforts in capability development.

In some cases, for example during extreme market disruption, the firm may be forced to retire a capability entirely, resulting in the capability "dying" within the organization. This may also occur if a legislative change occurs that forbids the firm from using said capability. In a less severe occurrence, the capability may not just be as needed as it

was prior, resulting in lower utilization and declines in productivity. This reduced utilization of capability would then degrade the level of capability proficiency and this is reflected upon in figure 7, where it is depicted as the retrenchment branch, where there is a gradual decline in the level of capability.

Capability replication takes place, when the firm aims to reproduce the same capability in another geographic market. Figure 7 illustrates capability replication as a rather simple process by continuing the capability's lifecycle with a straight line, however, capability replication can appear difficult due to the development needed to raise the capability to a pre-replication level. Alternatively, the firm can seek to redeploy the capability to a different product market, where this type of transfer often requires some alteration to the capability in question, in order to serve the new product market. However, there may be opportunities in additional redeployment of the capability. Redeployment of a capability can take a one of two forms, first being the sharing of a capability between an older market and the new market, and the second being an intertemporal transfer of capabilities from one market to another, thus enabling the firm to exit a declining old market in favour of a new market.

Capabilities can also be renewed or improved to address a need in raising efficiency. Winter (2000) notes that a crisis (for example, caused by a sharp rise in resource input prices) may trigger a motivation within an organization to renew and improve capabilities to remain competitive. The firm may also seek to recombine an existing capability with a new capability, and this may provide the firm with an opportunity to have an alternate approach in the current product-market. As an example of this the firm can combine its existing capability in manufacturing with a new capability in information technology to make its manufacturing capability more efficient (Helfat and Peteraf, 2003).

The key takeaway from understanding capability lifecycles is the fact that capabilities do not exist in a static state within an organizational vacuum, but face change due to varying different factors. The firm may find new opportunities in transforming its existing capabilities to fit a new market, either geographically or via a new product mix. The capability lifecycle, to an extent, follows the lifecycle of a product where it can identifiably have a founding, a development and a maturity stage. However, capabilities often span farther than product lifecycles as capability lifecycles can see many product lifecycles during their use. Pursuing redevelopment opportunities can take place due to changing market conditions or new available technologies and firms are often equipped varyingly to address these possibilities. Firms may also face situations where they are forced to

drop their existing capabilities to cope with changing environmental conditions and this forces these firms to start their capability lifecycles back from the founding stage.

2.2 Business models

In the second subchapter the concepts of business models and their connection to competitive advantage are illustrated. The subchapter explores the origins of the business model, what the elements are, and how the definition has changed through its history. This is done with an exploratory look at how different authors have defined the business model through its history and what the focus points have been in these different interpretations. This delve into the etymology of business models is followed up with a look at how the business model and the firm's core business are interconnected. This is then followed up with a look into how business models can be conceptualized. This look includes ideas on how business models can be built, developed and illustrated. The subchapter then concludes with a deeper look into the business model canvas framework and its later iterations, these being tools that are frequently used to describe business models in different types of firms.

2.2.1 Business model etymology

The term "business model" has gained most of its popularity in the past thirty years coinciding with the technology boom of the .com era in the 90's. However, the term goes back farther in history, appearing for the first time in an academic setting in an article by Bellman et. al (1957) and in the title and abstract of a research paper in 1960 by Jones (in Osterwalder, Pigneur and Tucci, 2005). In their article, Osterwalder and Pigneur (2005) point out that the number of times the term "business model" appeared in business journals (both peer-reviewed and non-peer reviewed) follow the pattern of the NASDAQ market index closely, and that the term was most frequently used in relationship with the internet during the steep rise of the NASDAQ stock market for technology-heavy companies in 1990's. Wirtz et al. (2016) added that with contexts in information technology, the term business model was used mainly in the sense of business modelling (process models). Additionally, Wirtz et al. (2016) noted, that the term referred possibly to a more comprehensive use by Konczal (1975) by applying the term as a management tool. However, following Konczal's paper, the business model continued to be used in mainly modelling operative activity for systematic modelling, and as such, was strongly characterized by its functional aspects.

In his PHD dissertation, Osterwalder (2004) emphasized the need for business models by recognizing that the current economic environment in which firms operate in is a competitive, rapidly changing and increasingly uncertain one, in which day-to-day business decisions are complex and difficult. Companies have found themselves with a breadth of new information and communication technologies to utilize, shorter product life cycles to hold on to, and with a new global market with new and tougher competitors to compete with. Conversely, Teece (2010) noted that the fundamental idea of a business model had existed since pre-classical ages. However, business models have been said to have gained significance after the advent of the Internet towards the later part of the 1990's. Zott, Amit and Massa (2010) further explained that the pace of use for business models as concepts has since only gathered more and more momentum, and continues to do so. Somewhat conversely, Osterwalder (2004) argued that the concept of a business model has become more popular in modern times, due to the fact that managers in modern times are overwhelmed with choices when it comes to defining their value proposition, or as it comes to configuring their value network, or as it comes to choosing their partners, or as it comes to looking for new ways for reaching customers or as it comes to any similar decision managers have to make rearing a company. Amit and Zott (2001) argued that the advent of the Internet has been the main driver in the use of the business model concept, and this, to an extent, reflects Osterwalder's (2004) view, as the Internet often allowed managers a broader selection of choices than ever before.

Conversing conceptualizations to the concept of the business model as a management tool also exist, as an example Al-Debei and Avison (2010) view the business model as an abstract approach to represent the company structure or its architecture. Surprisingly, but definitely very interestingly, in their study, Zott, Amit and Massa (2010) found that the term business model was most often used without an explicit definition of the concept. These types of studies often take the concept as more or less granted or anticipate the reader to make their own connections to what a business model constitutes. The rather young academic consensus around business models often leads to trail of thought where business models are seen as extremely necessary for coping with challenges posed by modern markets. As an example, Magretta (2002) characterized the business model as a fundamental concept to have to any organization. Even as the concept is taken as granted or explained in a rather 'fuzzy' way, business models are understood as a powerful way to understand, analyze, communicate, and manage strategically oriented choices (Al-Debei and Avison, 2010).

Since the year 2000, the concept of a business model has seen an increasing number of academic studies and non-academic articles dealing with the strategic dimensions of the concept (Wirtz *et al.*, 2016). The strategic importance of the concept was on the rise due to the vast differentiation of business models in its strategic understanding and as Osterwalder (2004) pointed out before, due to the sheer amount of choices managers had to make in choosing what their business model components would be. This lead to the term business model being used frequently with the new economy of the 2000's and the concept was picked up especially by non-academic sources, such as newspapers (Wirtz *et al.*, 2016). At the time, Porter (2001) described the state of business models followingly: "The definition of a business model is murky at best. Most often it seems to refer to a loose conception of how a company does business and generates revenue."

However murky the definition of the business model is, the philosophical understanding of its business model guides organizations to seizing opportunities they see with the resources they have. Magretta (2002) proposed that a good business model is capable of answering Peter Drucker's age-old question about "who is the customer?", and "what does the customer value?", but also exceeds into questions such as "how do we make money in this business?" and "what the underlying economic logic that explains how the value is delivered to customers is done at an appropriate cost?" Osterwalder and Pigneur (2002) add to this fundamental thought, of a business model, by arguing that a business model "is nothing else than the value a company offers to one or several segments of customers and the architecture of the firm and its network of partners for creating, marketing and delivering this value and relationship capital, in order to generate profitable and sustainable revenue streams." This business model value stream is illustrated below in figure 8.

Figure 8 *Business model value stream*

Often, when business models are discussed, the focus of the discussion is on a specific part of a business model rather than the sum of its components. This is partly due to the undefined nature of the business model where it is difficult to pinpoint what the components of the business model are. Recently, academic discussion has moved to-

wards a more universal understanding of a business model, however, there are still differences between what is understood as constituting a business model (Wirtz *et al.*, 2016). Abstract notions of business models describing “how firms do business” do not help the common consensus of a business model to become more established and for this reason, for the context of this study, an understanding of what different theories around the concept of business model there are, is drafted upon.

To gain a grasp on what the different definitions and goals of different interpretations of business models are, a comprehensive view must be taken in to the varying definitions and goals set by different authors. According to Wirtz et al. (2016) different interpretations of the business model can roughly be separated into three conceptual groups, where some business models are categorized by their technological orientation, some by their organizational theory orientation and some by their strategical orientation. As an example, Massa, Tucci and Afuah (2017) raise concerns that even in academic settings, some scholars still see the business model as a standalone term, whereas others may simply use it synonymously with the term “strategy”. Whereas others, such as Amit and Zott (2001) see the business model as a structural template to conceptualize how firms should operate in a technologically innovative world. To address the vast number of business model architectures, a non-exhaustive list of different conceptualizations is drawn and presented in table 2 below, including the authors, who have made the definitions and the years of publications when each concept had been made.

Table 3 *Business model concepts according to different authors*

Author(s)	Year	Business model orientation	General Definition	Concept of business model
Timmers	1998	Technological	Architecture	*An architecture for the product, service, information flows, including a description of the various business actors and their roles, a description of the potential benefits for the various business actors and a description of sources of revenue.*
Applegate	2000	Technological	Framework	*The Business model framework consists of three components: concept, capabilities and value, where concept defines the market opportunity, the strategy to obtain a dominant position with products and services, where capabilities are those that are usable by the firm, both internal and external and where value is the measurement of the business model, e.g. financial performance.*
Amit & Zott	2001	Technological	Template	*A business model depicts the content, structure, and governance of transactions designed so as to create value through the exploitation of business opportunities.*
Gordijn & Ackermans	2001	Technological	Conceptual tool or model	*An e-business model consists of 9 distinct components; an actor, a value object, a value port, a value interface, a value exchange, a value offering, the market segment, a composite actor, and a value activity.*
Porter	2001	Strategical	Statement	*A business model is a loose conception of how a company operates (does business) and generates revenue.*
Weill & Vitale	2001	Technological	Description	*Business models can be used to capture the essence of an e-business initiative, combining elements of five ways to represent a business: strategy, form, processes, value chain and core competences.*
Chesbrough & Rosenbloom	2002	Strategical	Framework	*The business model provides a coherent framework that takes technological characteristics and potentials as inputs and converts them through customers and markets into economic outputs.*

Table 4 *Business model concepts according to different authors, continued*

Magretta	2002	Strategical	Story	*Business models describe, as a system, how the pieces of a business fit together.*
Osterwalder & Pigneur	2002	Technological	Architecture	*A business model is nothing else than the value a company offers to one or several segments of customers and the architecture of the firm and its network of partners for creating, marketing and delivering this value and relationship capital, in order to generate profitable and sustainable revenue streams.*
Afuah & Tucci	2003	Technological	Conceptual tool or model	*Model for the Internet as a creator of new value for customers […] The model includes a degree to which new value is created, a degree to which functional capabilities are rendered obsolete, degree to which architectural capabilities are rendered obsolete and degree to which new product costs are lowered.*
Afuah	2004	Strategical	Framework	*Business models provide the framework to evaluate the potential economic value that can an organization can create by selling a product or service.*
Osterwalder	2004	Organizational	Conceptual tool or model	*The business model ontology consists of nine distinct building blocks that are: value proposition, target customer, distribution channel, relationship, value configuration, capability, partnership, cost structure and revenue model.*
Osterwalder et al.	2005	Organizational	Conceptual tool or model	*The business model serves as a building plan that allows for designing and realizing the business structure and systems that constitute the company's operational and physical form.*
Tikkanen et al.	2005	Organizational	Framework	*Business models consists of four conceptual levels of managerial cognition: industry recipe, reputational rankings, boundary beliefs and product ontologies.*
Zott & Amit	2007	Organizational	Description	*A business model depicts the content, structure and governance of transactions designed so as to create value through the exploitation of business opportunities.*

Table 5 *Business model concepts according to different authors, continued*

Al-Debei & Avison	2010	Organizational	Structural layer	*The business model operates in a layer between the business strategy and the business process model, where information is the key driver.*
Baden-Fuller & Morgan	2010	Organizational	Structural layer	*The business model is like the biological model organism – an incredibly complicated set of arrangements where every slight change in one bit is likely to alter all the other relationships.*
Demil & Lecocq	2010	Strategical	Framework	*A business model consists of six key components: resources & competences, value propositions, internal and external organization, volume & structure of costs, volume & structure of revenues and margins.*
Osterwalder & Pigneur	2010	Organizational	Conceptual tool or model	*Business models consist of nine building blocks: value propositions, customer segments, channels, customer relationships, revenue streams, key resources, key activities, key partnerships and cost structure.*
Teece	2010	Strategical	Architecture	*A business model describes the design or architecture of the value creation, delivery, and capture it employs.*
Amit & Zott	2013	Organizational	Template	*A business model is a template that depicts the way the firm does business.*
Bankvall et al.	2017	Organizational	Set	*The network-embedded business model encompasses a set or network of firms involved in business exchanges that can only be understood and described at the network level.*
Laasch	2018	Organizational	Set	*The business model extends beyond the purely commercial aspect […], the business model is a concept of organizational value logics.*
Visnjic et al.	2018	Technological	Description	*The business model concerns the way how value is created through accountability to customers.*

Table 2 illustrates the fact that there is no unifying concept of a business model that would combine the concepts given by different authors. Even the main focus area of each author's study can vastly vary, even as each author publishes different concepts along different years of publication. Wirtz et al. (2016) note that till the 2000's it was rather simple to divide different author's works into different basic business model orientations. However, it has since become significantly more difficult, as many current works refer to different foundational works by the listed authors. Wirtz et al. (2016) also added that during the 1990's technological boom, a great number of studies were published that regarded the technological business model orientation of the firm. Even authors that had published technologically oriented papers during that period, have moved to a more abstract level through organizational or through purely strategical writing of the business model concept.

Even when there is a vast range of different types of interpretations of what constitutes a business model, there are some commonalities between different concepts. For one, the aspect of strategy is a common one between different models. However, the way strategy is perceived may differ between different models. Secondly, the business model, as a concept, is defined by terms that closely resemble 'abstract' and/or 'conceptual rather than specific tangible elements. Third, as an overarching theme business models appear to incorporate the concept of value generation and value capture in the conceptualization of the models, however the source of value may vary greatly. Some business models emphasize the revenue generation side of the model where as others balance revenue with cost structure. However, as a fourth notation between different models, one can see a similarity in the sense that many of the models regard the monetary side of the business in some sense in their model. Finally, when one looks at a more modern interpretations of a business model, a commonality is in the network perspective of the business model. Many of the business model interpretations acknowledge that the modern market requires co-operation and/or co-opetition between companies to drive growth, and thus, the scope of business models needs to be extended.

It is easy to understand that the concept of a business model is rather fuzzy and hard to define, and although many authors do leave the business model without an illustrative description, it needs to be understood what the reasoning behind the business model is. Osterwalder (2004) argues that in its simplest form the business model will be a model related to "the activity of buying and selling products and services" and "the activity of earning money". Now, if a business model is understood by its very simplest form of earning money through buying and selling goods and services, one can arrive to a line

of thought that leads them to the very basic tenets of strategy. A traditional value chain approach would follow the exact same line of thought where each chain participant procures inputs, adds value to said inputs and then sells outputs in favour of turning a profit (Porter, 1991). However, the business model concept is a more expansive one that spans further than its very simplest form and often regards areas beyond turning inputs into outputs.

Business models are needed to address issues that rise in the modern markets, such as faster industry clock speed, increased complexity and the nature of uncertainty that is present in the modern marketplace. Osterwalder (2004) argues that the business model concept could help managers by equipping them with tools to better adapt to rapid changes in the market, by lowering, at least, some parts of the complexity of the modern market by illustrating focus areas in a structured manner and by enabling managers to be more prepared for an uncertain future with many possible outcomes. Magretta (2002) adds that effectively implied business models may offer companies positions that are harder to replicate, and thus, may provide them with strong competitive advantage in the market. Additionally, Amit and Zott (2013) emphasise the fact that the business model and the firm's product market strategy can often complement each other, enhancing the firm's performance in the long run. Business models can often provide a common language between the stakeholders of the firm and enable strategic discussions better versed for a multitude of different possibilities.

The business model concept can be critiqued due to some of its flaws in its application, as the business model concept still requires further development to be fully explored. Amit and Zott (2013) describe the business model concept having unresolved overlaps with other established concepts, levels of theory and analyses often leading to a situation where different concepts are used interchangeably. This can lead to ambiguity in practical use and lead to business models being too broad to be applied in the practical world. The current interpretation of the business model can also seem all-encompassing in its design, covering almost everything related to the firm, resulting in a situation where it is difficult to make a distinction about what the business model is *not*. The business model concept, though used empirically in various fields and instances, still lacks empirical backing in practicality.

For the context of this study, an important distinction between strategy and business models has to be drawn – as if both of these terms are used interchangeably, one can arrive in very different interpretations of the results. First the business model concept

often views activities and linkage through the lens of an entire value network, rather than organizing internal configurations. As in traditional strategic thinking a key choice in business can be the issue of what activities should the firm focus on rather than a broader question of who should do those activities. Secondly, business models often relate to absolutes in business logics, absolute revenue streams, absolute costs, and absolute value propositions, whereas strategies often look at the relative business logics of the firm and its competitors. Importantly, Osterwalder (2004) made a distinction, where the firms business layers can be divided into three separate layers with different illustrations and different levels of thought, illustrated below in an adapted figure 9.

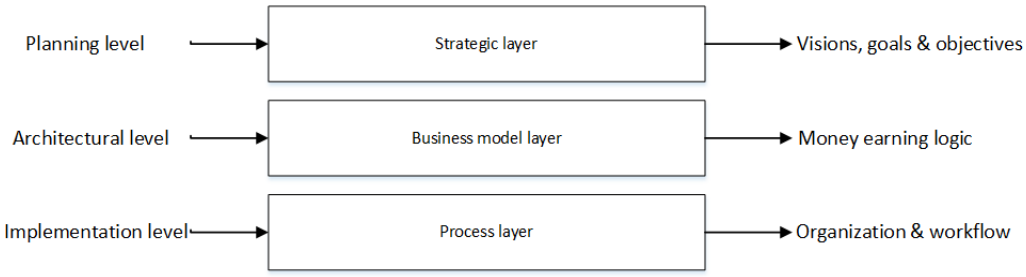


Figure 9 *Business layers, adapted from Osterwalder, 2004.*

In accordance to Osterwalder's (2004) distinctions between the strategic layer, the business model layer and the process layer, this study adopts a distinction between these foundational concepts and adopts the idea that the business model is focused mainly in the choices of activities and fits across the value network.

2.2.2 Interaction between the business model and core business

In order to understand the interaction between the business model and the core business of the firm, it is important to understand where the business model is located within the given firm. Conceptually, the business model appears to be a facilitator between the firm's business strategy, the firm's business organization and the firm's information and communications technology (ICT). The business model is applied on its business model layer, refer to prior subchapter, between the strategic layer consisting of the business strategy of the company and the process layer, consisting of the ICT of the firm and business organization of the company. According to Osterwalder (2004) these layers are subjected to continuous external forces forcing the manager of the company to respond

to them, mainly through the use of the business model. This is illustrated below in Figure 10, adapted from Osterwalder (2004).

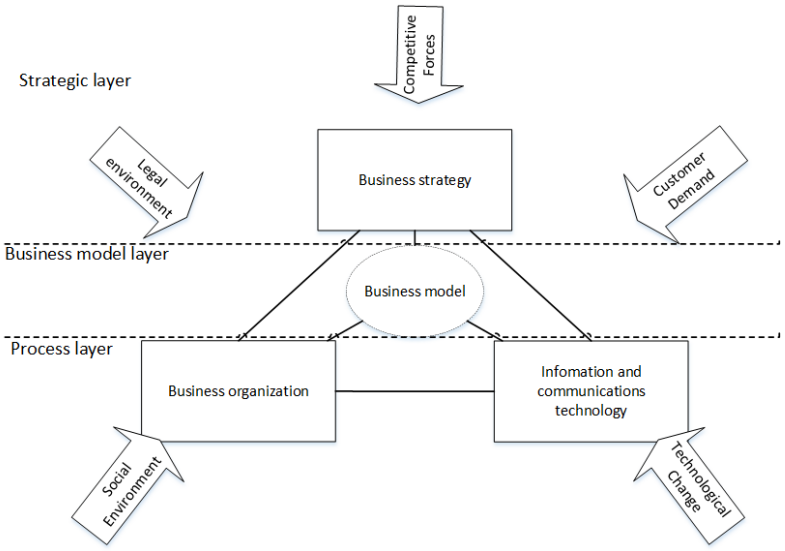


Figure 10 *Business model and its link to Strategy, ICT, and the Business organization, adapted from Osterwalder, 2004.*

The business model often provides the link between the strategy of the firm and its business organization and the information and communications technology it uses, which are often separated in an organization with a gap (Osterwalder, 2004). There has been a number of studies attempting to connect business models and corporate performance. Furthermore, corporate performance is often used as a metric to measure how well the core business of the company is doing, and as such, it is important to take a look at different interpretations in how the business model is affecting corporate performance within different metrics. For the extent of this study, three key performance indicators were chosen; the stock price of the company, the profits of the company and the revenue of the company. Illustrated below in table 3, a non-exhaustive list can be found separating studies on business models under these three key measures of performance.

Table 6 *Business models & Corporate performance measures*

Stock price	**Revenue**	**Profits**
Boulton et. al, 2000	*Chesbrough, 2007*	*Betz, 2002*
Mitchell & Coles, 2004	*Glick, 2008*	*Johnson et al., 2008*
Yip, 2004		*Casadesus-Masanell & Ricart, 2011*
Amit & Zott, 2012		

Though somewhat removed from the reality of the firm's core business, it is important to understand how an effectively applied business model can affect the company's corporate performance, thus, reflecting on its core business. In their article, Boulton et al. (2000) argued that an effective business model in the new economy had a significant impact in the book value of the company, even when different companies had the same income and revenue numbers. Boulton et al. (2000) noted that during the dot.com boom in the beginning of the 90's through the year 2000 US companies AOL and Time Warner, had both grown significantly. However, during year 2000, AOL, with revenues of 5,7 billion$ (with a profit of 1 billion$) was valued at the market at 128,5 billion$, whereas Time Warner, with revenues of 23,5 billion$ (with a profit of 1,3 billion$) was only valued at around 70% of that of AOL at 93 billion$. Boulton et al. (2000) argued that this was due to a superior business model better suited for the landscape of the current business landscape.

Mitchell & Coles (2004), in their similar study, based on the stock price development of companies, evaluated the connection between business model innovation breakthroughs in established large companies during the period of 1989-2003 and their effect on the stock price development of the respective companies. Mitchell & Coles (2004) concluded that regardless of the CEOs skill in developing business model innovation ideas to apply in the company, such efforts would be the primary source of the company's future success. Mitchell & Coles (2004) added that establishing and extending industry-leading business model breakthroughs within an organization often required eliminating prior elements of the business model of the company. However, these types of eliminations of business models often lead to improved performance, and thus, leading into elevated stock evaluations.

Similarly, Yip (2004) and Amit and Zott (2012) reflected upon the internet based business models of a pair of companies, and made a connection between the novelty of the business model and increased stock market success. These novelty-based business models often lead to the companies finding significant edge over their competitors leading into market value development that outperformed their rivals. Thus, business model innovation could be linked to the stock price development of the firm's that took these types of opportunities to launch novel activities. However, critique can be raised in using stock price as an indicator for corporate performance, as stock prices are prone to fluctuations and market prices may vary due to market speculation. Similarly, this would narrow the results to only listed companies and would then fore-go non-listed companies entirely.

Commonly used measurement of corporate performance is the turnover of the company. Connecting this with business models, however, seemed fairly rare, and search results through article databases commonly lead to articles considering revenue models within business models. Chesbrough (2007) indicated that business models saw innovation mainly through new revenue source searches, and as such a new novel business model could be judged by how well it had affected the company's revenue and to an extent how much of that revenue was coming from the business model innovation in question. Though Chesbrough's article considered the effects of business models to revenues in a fairly broad way, Glick (2008) applied similar performance metrics in measuring how effective connections and synergies with partners within a value chain could be to an organization.

Turnover, similar to stock price evaluation, can lead to misleading perceptions of corporate performance and as such, this study aims to bring one more corporate performance measure in profits. Studying strategic business models, Betz (2002), found that a good business model was often necessary for an individual company to find profitability. In his article, Betz (2002) analysed the experience of new dot.com companies in the Internet growth years of 1996-2000, where a huge number of these companies received extensive venture capital funding and had significant opportunities to turn their companies profitable. Betz (2002) noted that many of these companies went bankrupt in the year 2000 without ever becoming profitable and this was often due to the lack of a good business model. Johnson, Christensen and Kagermann (2008) extended this idea by elaborating that a successful business model could be identified by having a system that included key resources, key processes, an effective customer value proposition and quite an extensive profit formula for the company. Johnson, Christensen and Kagermann (2008) illustrated several examples where business model innovation could have a significant effect in the firm's profitability, thus providing a link between profitability and effective business model application.

Business model choices can have several different impacts to corporate performance measured through different metrics. Osterwalder (2004) notes, that on the strategic layer of the company, 'business people' position the company in the market to define the direction and to formulate objectives and goals. For this to be a smooth application to the process layer of the company, i.e. the core business of the company, a business model is needed to clear the communication of concepts and understandings between the 'business people' and the 'process people'. Osterwalder (2004) breaks the interconnection

between the business model and the process layer into two distinct connections: the connection between the business model and the business organization and the connection between the business model and the ICT of the firm.

The business model and the business organization of the firm as closely related, as changes in the business model often bring up organizational questions, which can be illustrated through the fact that established firms couldn't structurally cope with their online counterparts in the 90's (Osterwalder, 2004). The firm's business organization can be optimized through a good understanding of the infrastructure side of the business model and by precisely defining aspects, such as the supply chain and the partnerships required in addressing questions related to other areas of the business model.

Similarly, ICT and the business model exhibit a strong link between each other (Osterwalder, 2004). As a reminder, technological leaps in ICT kickstarted the wave of business model studies back in the dot.com era resulting in a vast number of studies conducted in the area. Osterwalder (2004) points that sometimes the link between ICT and the business model within the firm can be self-evident, for example, in the case of online companies such as Facebook and LinkedIn. However, the link does not have to be as apparent. Additionally, technological advances have made it easier for companies to offer novel value propositions while having fairly low impacts on costs, thus, allowing companies to enrich their products and services with ICT-based components.

For the extent of this study, the key takeaways should be that the business model can help strategists convey the vision and the goals of the firm to the process layer of the company. Thus, providing the process layer the framework in how the core activities should change (if a change is needed). An effective business model can have significant impact in corporate performance through different metrics and as such, an argument could be made that business modelling should be done in firms that aim to increase their performance.

2.2.3 Modelling business models

Osterwalder, Pigneur and Tucci (2005) explained that a great amount of the confusion caused by business models, stemmed from the fact that different authors write synonymously about business models while not necessarily meaning the same thing between each other. In academic (and non-academic) literature the business model can stand for many different things, such as parts of a business model (e.g. revenue model), types of business models (e.g. vendor-managed-inventory model), concrete real-world applications of business models (e.g. the IKEA model) or concepts (elements or relationships between models). Osterwalder, Pigneur and Tucci (2005) argue that business models can be categorized in three different subsets: those that use an overarching business model concept, those that use taxonomies and those that use instance level business models.

The first level, the overarching business model concept, defines what a business model is and what belongs in it, while also including the meta-models that conceptualize the business model. On a meta-level, business models can be seen as abstract concepts of describing what the business does for a living, following with a simple idea of what a business model is and by defining what elements can be found within a conceptual business model. On the first level studies, some authors extensively focus on rigorous modelling of a business model. (Osterwalder, Pigneur and Tucci, 2005)

The second level, consisting of the taxonomies level, consists of several types or meta-model types of business models that are generic but contain commonalities between each other. The prior is often used as a simple categorization, whereas the latter refers to different models. Business model types can be perceived as a sub-class of the first-level model; however, they do not necessarily resemble first-level models. Business model taxonomies are often tied to a specific industry, such as gaming or broadcasting. (Osterwalder, Pigneur and Tucci, 2005)

The final, third level models consist of concrete real-world business models and/or conceptualizations, representations, and/or descriptions of real-world models. These business models are often well-known examples and are used to analyse companies in depth. Examples of this include the Gillette-model (the razorblade model) or the IKEA model (consumer-engaging model).

In the context of this study, the adopted definition of what constitutes a business model follows the first-level model category, that see business models as overarching, constituting of its components and of its the elements present. This is to limit the number of different types of business models considered, as a common understanding is formed on how to model a business model is given. To grasp this objective, it is important to understand how different authors approach the subject. This limitation also makes it easier to differentiate and compare different models from each other and assigns somewhat of a descriptive characterisations to each.

In the first section of this subchapter, in 2.2.1, discussions made it clear to what extent the definition and the perspective of the term business model could vary. With differing concepts of a business model, it becomes quickly apparent that in a component-oriented view of a business model there has to be a vast variety of components each author would include into a business model. However, as a commonality between different understandings of the business model, there is a overarching fact that the business model concept includes several sub-models, such as the revenue model or the value model. Wirtz et al. (2016) emphasises the fact, that there is no universal consensus between authors on what components constitute a business model, and as such, it is essential to have an exploratory view on how different models overlap and how different models differ from each other. Below, in table 4, a non-exhaustive list of business model components can be found according to different authors. It should be mentioned that the components selected in this study are done in this way to enable comparative results between different models' components. Components listed include: Strategy, Resources, Partners, Customers, Value proposition, Activities, Procurement, Revenue and the Cost structure.

Table 7 *Business model components according to different authors*

Compo-nents / Author	Strategy	Resources	Partners	Customers	Value proposition	Activities	Procurement	Revenue	Cost structure
Applegate, 2000	Concept	Capabilities			Value				
Gordijn & Ackermans, 2001		Actor		Market segment	Value offering	Value exchange, value activity			
Weill & Vitale, 2001	Strategic objective	Core competences, IT infrastructure		Channels, customer segments	Value proposition	Critical success factors		Sources of revenue	
Hedman & Kalling, 2003	Managerial & organizational	Resources		Customers	Offering	Activities & organization	Suppliers, Factor markets		
Afuah, 2004	Positions	Resources			Industry factors	Activities			Costs
Yip, 2004	Scope, differentiation	Organization		Nature of customers, channels	Value proposition	How to transform inputs	Nature of inputs		
Osterwalder, 2004		Capability	Partnership	Target customer, distribution channel, relationship	Value proposition	Value configuration		Revenue model	Cost structure
Osterwalder et. al, 2005		Core competency	Partner network	Target customer, distribution channel, relationship	Value proposition	Value configuration		Revenue model	Cost structure
Tikkanen et al. 2005	Strategy & structure		Network			Operations		Finance & accounting	Finance & accounting
Al-Debei & Avison 2010			Value network		Value proposition, value architecture			Value finance	Value finance
Demil & Lecocq, 2010		Resources & competencies, organizations			Value proposition			Volume & structure of revenue streams	Volume & structure of costs
Osterwalder & Pigneur, 2010		Key resources	Key partners	Customer relationships, channels, customer segments	Value proposition	Key activities		Revenue streams	Cost structure

It becomes even more apparent in table 4, that the business model's components vary greatly between different models, similar to how business models are differently defined by different authors. The formation of a business model from smaller components is shared between all the tabled business models however. Similarly, it is immediately noticeable that most business models share the fact that each include a pool of resources and a value proposition, the value proposition making an appearance in almost every model. To provide context for this study, each listed item is described shortly.

Strategy is present in half of the chosen business model structures. However, how each model describes strategy, differs between each one. As an example, Weill and Vitale (2001) include a "strategic objective" in their model of the business model, this strategic objective being what choices and trade-offs the firm makes in order to offer its target customers a unique and valuable proposition. Hedman and Kalling (2003) include a strategic view that is both managerial and organizational in their business model concept, where the firm makes organizational strategic choices in a longitudinal dimension,

considering its constraints on actors, cognitive and social limitations. Hedman and Kalling (2003) also illustrate in their model that both the supply side and the market side of their model is prone to external pressures according to Porter's five forces model. In his version of the model, Afuah (2004) emphasizes the need for the firm to consider how it positions its value proposition in the market. Similar to Afuah (2004), Yip (2004) emphasises the choice of scope and differentiation in his model, and links these questions with the foundational question of how inputs are transformed.

As previously mentioned, the **Resources** component is a common one between many business model descriptions. This can be found present in all but two business model descriptions (present in Applegate, 2000; Gordijn and Akkermans, 2001; Weill and Vitale, 2001; Hedman and Kalling, 2003; Afuah, 2004; Osterwalder, 2004; Yip, 2004; Osterwalder, Pigneur and Tucci, 2005; Demil and Lecocq, 2010; Osterwalder and Pigneur, 2010). The inclusion of resources in each model can partly be due to the fact that the resource-based view has often been the basis, upon which business models have been built upon. The nature of resources between each model, however, differs depending on the model in question. Some emphasize the capabilities of the organization and the core competencies of the firm whereas others use a broader understanding of resources.

Partners were not commonly found in early iterations of business models. However, the role of partners in business networks and in larger ecosystems has risen significantly as the year 2010 was getting closer. Osterwalder, Pigneur and Tucci (2005), Tikkanen et al. (2005) and Al-Debei and Avison (2010) illustrated that the role of partners is important as firms find themselves in a value network, where companies do not exist in a vacuum, but are reliant on the companies around them.

Customers play an important role in business models as the targeted customer segment often sets requirements to the unique value proposition that the firm aims to offer to them. Customers in this list include the customer segments, i.e. who is the customer the firm wants to offer the value to, the channel, i.e. how does the firm get in touch with its customers and the customer relationships, i.e. what kind of link exists between the customer and the firm (this is often established by the firm and not the customer).

The value proposition is arguably the most important part of the business model, and therefore, is included in all but Tikkanen et. al (2005). According to Osterwalder and Pigneur (2010) the value proposition is the reason why customers choose one company

over another. The value proposition consists of a bundle of products and services that are of value to a specific customer segment. Osterwalder and Pigneur (2010) add that some value propositions may be innovative and some may even represent new and disruptive offers to customers. It is apparent (in this list and in academic research) that the role of the value proposition is emphasized the most in business models overall.

Activities describe the actions the firm must take to operate. Zott, Amit and Massa (2010) explain that activities can be performed by either the focal firm or by any of its suppliers, partners, or even customers. The definition of an activity is often recurrent in business models and describes and action the firm takes on a day-to-day basis. Osterwalder and Pigneur (2010) make a distinction by calling some activities key activities in their model, representing a set of the most important activities the firm does to operate successfully. Activities may vary between different business models as some activities can be industry specific (e.g. software companies have to develop software whereas hardware companies may not have to develop software).

Procurement is less common among business models and is only included in two different concepts in table 4. Hedman and Kalling (2003) include procurement in a sense that for an organization to produce outputs, the firm needs inputs that it procures from its suppliers. Hedman and Kalling (2003) separate suppliers into two groups, the factor markets and the production input suppliers.

Finally, in most business model interpretations two components regarding financial aspects are included. These are the **Revenue** and the **Cost structure** components. Some authors, e.g. Al-Debei and Avison (2010) and Tikkanen et. al (2005) do not separate financial aspects of the firm into revenues and costs, but use a single component of finance instead. In non-academic literature, the revenue side of finance gathers significantly more interest and the revenue model is often used synonymously with the concept of business model in day-to-day conversation. Revenue models may include different types of pricing mechanisms, such as recurring revenues and transactional revenues (Osterwalder and Pigneur, 2010). Furthermore, the role of the cost structure in business models is to represent all the money employed in the business model. Costs may incur from a variety of sources. However, it can be often difficult to pinpoint all the costs related to a chosen business model.

On canvas models

As there is now an understanding, in accordance to prior discussion in this section, a business model can consist of a number of components and for this study the business model framework used will be an iterative version of the business model canvas. Prior discussions in this section provided a reasoning why different areas of the business model are included in each model such as a canvas model and should provide context in why each component is included.

In the context of this study, the baseline of a business model is set to the business model canvas introduced by Osterwalder and Pigneur (2010). The business model canvas (appendix A) is a conceptual tool that is based on a definition of a business model describing the rationale of how an organization creates, delivers, and captures value. The business model canvas tool consists of nine building blocks, in order of significance:

(1) Customer segments
(2) Value propositions
(3) Channels
(4) Customer relationships
(5) Revenue streams
(6) Key resources
(7) Key activities
(8) Key partnerships
(9) Cost structure

The business model canvas is iteratively based upon the business model ontology presented by Osterwalder (2004), that is based upon a framework that names four key areas a business model should address:

- The product
- The customer interface
- Infrastructure management, and
- The financial aspects

Osterwalder (2004) notes that the four areas can be compared to the four perspectives presented by Norton and Kaplan in the balanced scorecard (BSC) framework. The

BSC framework was introduced in the early 90's to help managers monitor and measure non-financial metrics of the firm. According to Osterwalder (2004), the business model should answer following questions about the framework:

- What business is the firm in, what are the products and value propositions offered to the market?
- Who are the company's target customers, how does the firm reach these customers and how does the firm build a strong relationship with them?
- How does the company efficiently perform infrastructural or logical issues and with what kind of a network?, and
- What are the financial aspects of the business model, what provides sustainability to the business model?

The business model canvas is a high-level abstraction model that is used for broader level business modelling. However, the business model canvas tool is very popular among managers and practitioners (Massa, Tucci and Afuah, 2017). Massa, Tucci and Afuah (2017) critiqued the business model canvas model as a "generic" business model that is assumed to be valid for describing many firms, adding that the business model canvas (like other business models) reflect what the authors of the model consider to be critical components for the model, and as such, universality cannot be drawn from a tool like the business model canvas.

The business model canvas provides a conceptual structure that can be used for empirical illustrations of the business model and can be adapted to suit specific needs of the user. After its antecedent had been published in 2004, different canvas models have been introduced based on the original model. For example, to address societal issues raised by Seelos and Mair (2005), a triple layered business model canvas was introduced by Joyce and Paquin (2016). The model introduced by Joyce and Paquin separated the business model canvas into three layers that follow the original canvas model, first one being the economic business model canvas, the second one being the environmental life cycle business model canvas and the third one being the social stakeholder business model canvas. Similar adaption was made by Zolnowski, Weiß and Böhmann (2014) who introduced the service business model canvas. The service business model canvas, unlike the triple layered business model canvas, was based on Osterwalder's (2004) original business model ontology framework rather than the more modern business model canvas framework proposed by Osterwalder and Pigneur (2010). Zolnowski, Weiß

and Böhmann (2014) propose a service business model canvas that consisted of the original nine building blocks. However, having each of the blocks divided into three distinctive perspectives; the partner perspective, the company perspective and the customer perspective.

Very similar to Zolnowski, Weiß and Böhmann (2014), Hakanen et al. (2016) introduced their iteration of the business model canvas better suited for IoT enabled business models called the service-oriented business model canvas. Hakanen et al. (2016) argued that a new, better suited, business modelling tool is required for describing the IoT business model of the future. However, Hakanen et al. (2016) acknowledged prior IoT based business model studies (e.g. Dijkman *et al.*, 2015), based on the prior business model canvas tool introduced by Osterwalder and Pigneur (2010).

In the context of this study, the canvas tool that is mainly focused on, is an adaptation of the business model canvas tool by Osterwalder and Pigneur (2010) by Maurya (2010) called the lean canvas (appendix B). The lean canvas tool iterates on the business model canvas model by combining it with elements of lean thinking. Womack, Jones and Roos (2003) describe lean principles originating in the early seventies in Japan by Toyota, that developed lean manufacturing in order to optimize production processes. The core tenet of lean principles is to make the production process more efficient by reducing any sort of waste in the process or through elimination of needless or redundant activities or expenses. Since then, lean principles have become well known even in non-manufacturing related contexts. A popular concept of a “lean start-up” was coined by Ries (2011), that is now used throughout different types of innovation projects in different disciplines. Ries (2011) explained that the goal of a lean start-up is to create a continuous feedback loop that allows customers to give feedback during development cycles.

According to Maurya (2010) the lean canvas is a combination of the business model canvas tool and the concept of the lean start-up introduced by Ries (2011). Similar to the business model canvas, the lean canvas consists of nine distinctive building blocks, that are in order of reflecting their relative importance:

(1) Customer segments
(2) Unique value proposition
(3) Channels
(4) Unfair advantage
(5) Revenue Streams

(6) Problem
(7) Solution
(8) Key metrics
(9) Cost structure

The lean canvas and the business model canvas share several components, however, the lean canvas substitutes *value propositions* with the concept of *unique value proposition*, *customer relationships* with *unfair advantage*, *key resources* with *problem*, *key activities* with *solution* and *key partnerships* with *key metrics*. This is done to better fit the situation most start-ups see themselves in, as many start-ups do not possess value propositions in its plural form but are usually working on their first or second product or service. Start-ups often do not have existing customer relationships with their potential customer base but have an idea on how to capture the target market segment, through early adopters.

Start-ups often lack resources, pre-existing activities and partnerships as well, and therefore, all of these are replaced in the lean canvas model as well. The lean canvas, originally designed to illustrate a business model of a lean start-up, can also be used in the context of illustrating business models for new innovations. In the context of this study, the field of IoT is fairly new to many established players and is spawning many new lean-at-birth organizations on a regular basis. As such, the lean canvas can accurately reflect upon the current situation of the state of IoT. Due to technological evolution cycle times getting rapidly faster, it should be mentioned that if this study was conducted on a later time period, these results could differ significantly. Additionally, for this reason, the lean canvas tool appears as a suitable framework for illustration.

2.3 Innovation ecosystems

The concept of an innovation ecosystem is not necessarily a self-evident one, and studies in the area are rather young in comparison to concepts introduced in the prior two subchapters. A quick search on the Cambridge Business English Dictionary does not return results for the combined term of an ‘innovation ecosystem’, however it defines the two separate terms as:

- ***Innovation****: a new idea, design, product, etc.,* or *the development of new products, designs, or ideas*

- ***Ecosystem*** (commerce)***:*** *a group of businesses or business activities that affect each other and work well together*

These two definitions combined explain the innovation ecosystem as a *group of businesses or business activities that affect each other and work well together in developing new products, designs or ideas.* This representation would be a rather simple one, as innovation ecosystems can appear more complex in practice, with different practical motivations and goals between organizations. In its simple definition, the ecosystem is used to describe a group of business, whereas in the empirical world, ecosystems, particularly innovation ecosystems, can span to cover the firm's suppliers, customers, competitors and complementors (Adner and Kapoor, 2010).

In this subchapter, the definition of the innovation ecosystem is first explored, with a look into how innovation ecosystems are formed. The innovation ecosystem is a highly specific ecosystem construct, and therefore, a complementing look into the concept of a simpler business ecosystem is accompanied in the first section of this subchapter. As the concept of an innovation ecosystem is not a universal one, this subchapter aims to provide an overview on how different authors perceive the concept. This is then followed up with a section on the concept of value generation within an innovation ecosystem construct. This subchapter aims to provide subtext in the particularities of the previously introduced concepts of capabilities and business models in the context of innovation ecosystems, thus, connecting the theory background of this study.

2.3.1 Innovation ecosystem formation

Similar to how the network approach has gained prominence in business model literature (Massa, Tucci and Afuah, 2017), the concept of a business ecosystem has become more and more prevalent after the 90's dot.com development (Adner and Kapoor, 2010). In business strategy, one of the earliest papers in the subject was written by James Moore (1993) in "Predators and Prey: A New Ecology of Competition". Moore (1993) argued that modern successful innovative businesses cannot evolve in a vacuum, in that they need to attract resources of differing varieties, drawing in capital, partners, suppliers and customers to create networks in which to co-operate. In literature, these types of networks were often described as strategic alliances. However, the concept left managers unsure about their strategic goals when entering phases of rapid innovation (Moore, 1993).

Nalebuff, Brandenburger and Maulana (1996) described the ecosystem construct through a system they introduced as the value net. The value net recognized that the firm is constantly connected to its customers, complementors, suppliers and competitors, where the firm could be found in the apex of all four. Illustrated below in figure 11, adapted version of the value net is illustrated, as one of the earlier interpretations of a business ecosystem

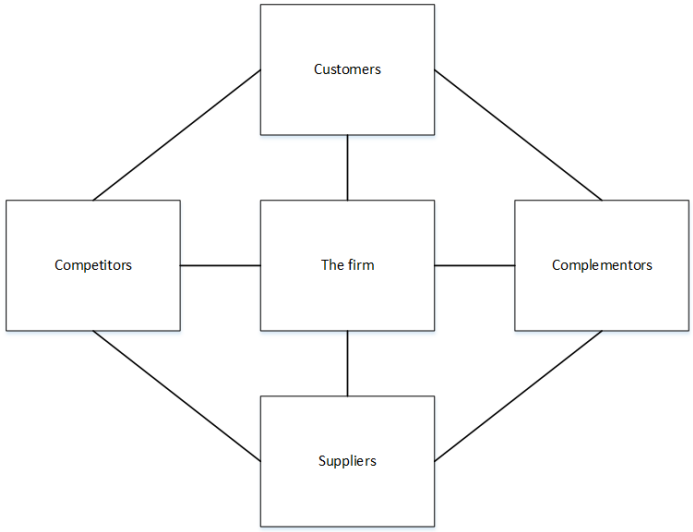


Figure 11 *The value net, adapted from Nalebuff, Brandenburger and Maulana, 1996*

The value net, proposed by Nalebuff, Brandenburger and Maulana (1996), reflects on the concept of an ecosystem given by Moore (1993), who suggested that a single firm should not be looked as a member of an industry, but rather as a member of a business ecosystem spanning many industries. Moore (1993) added that companies in a business ecosystem co-evolve their capabilities around new innovations, working co-operatively and competitively with each other, to provide customers new products that satisfy their needs in a cyclical manner, where new innovations are introduced over time.

Though many of the value net participants are self-explanatory or are defined earlier in this study, the concept of complementor requires a more detailed explanation. Nalebuff, Brandenburger and Maulana (1996) define the term complementor as a value participant that, with their offering, increases the value of the focal firm's offering. The firm, thus, generally wants to surround its offering with complementing offerings that all together increase the customer value received. Nalebuff, Brandenburger and Maulana (1996) extend the concept of complementors to also include supply side complementors

that are companies that make it more attractive to supply resources to the focal firm when supplying resources to the complementor firm.

The value net offers a fairly simple look of what an ecosystem structure could be and is raises the idea that the focal firm is connected to a network of other participating firms. However, the value net only illustrates links between different firms and does not make judgements on how the different companies are linked. However, the network/ecosystem structure, due to increasing market complexity and interconnectivities, has raised general interest in the topic and gathered significant interest from different academic authors. Similar to Nalebuff, Brandenburger and Maulana (1996), Adner and Kapoor (2010) presented their simplified version of the business ecosystem followingly, as seen in figure 12.

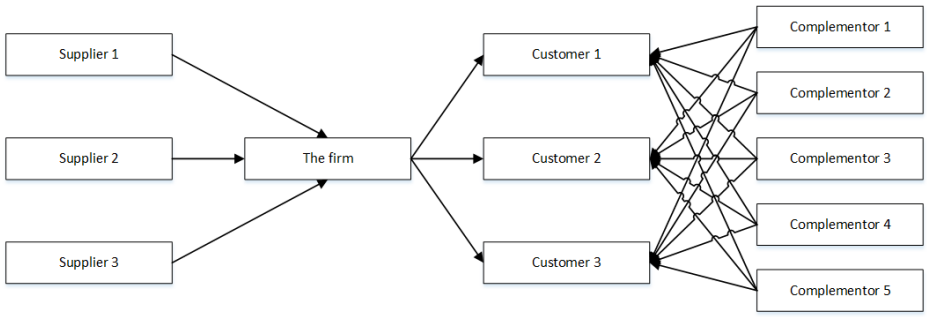


Figure 12 *Simplified Business Ecosystem, adapted from Adner and Kapoor, 2010*

In their interpretation of the business ecosystem, Adner and Kapoor (2010), assign a direction, a flow of inputs and outputs to their model to exemplify the role of the firm in the schema. Among others, Iansiti and Levien (2002) picked up the concept of a business ecosystem and explained that the networked structure had its emergence in the boon of the computing industry gaining massive ground. Iansiti and Levien (2002) explained that these networked structures, more specifically business ecosystems, exhibit a high degree of interconnectedness and various forms of modularity. Iansiti and Levien (2002) expressed that, in academic literature, one of the goals has historically been connecting even the simplest of components in the right way, so that even the most complex and difficult problems become solvable, thus creating new capabilities. The business ecosystem as a whole, then exceeds the sum of its parts and is able to solve even more complex problems than any of the individual firms could. This idea has deep roots within the notion of a firm's distinctive competence, that had extensive study in the form of the

resource-based view of the firm (e.g. Wernerfelt, 1984), the core competence of the firm (e.g. Prahalad and Hamel, 1990) and organizational learning emphasized by the dynamic nature of their environment and the dynamic capabilities often required for sustainable firm performance (e.g. Teece, Pisano and Shuen, 1997). Thus, business ecosystems often appear as an answer to an uncertainty caused by innovation in the market.

In Moore's (1993) business ecosystem concept, he identifies four distinctive evolutionary steps a business ecosystem takes on its lifespan, describing possible challenges that may arise from each step. A business ecosystem generally follows these following steps in its evolution:

(1) Birth
(2) Expansion
(3) Leadership
(4) Self-renewal

In the *birth* phase of the evolution, the firm must work with its customers and suppliers to define new value propositions around an innovation, that is seeding the birth of the ecosystem. The firm must also be able to protect its ideas from others that may be working with similar offers, as this can be done by connecting to critical lead customers, key suppliers and important channels for the innovation growth. (Moore, 1993)

The *expansion* stage challenges the firm to bring the new offer to a significantly larger market by working with suppliers and customers to scale up the business and achieve higher market coverage. Competitive, alternative implementations often appear at the same time with similar ideas, and according to Moore (1993) the firm should be able to ensure that their approach by establishing the market standard to ensure domination in key market segments.

The *leadership* phase encompasses a shift for the firm, where the firm must provide a compelling vision of the future to suppliers and customers in order to incentivize working together, improving the value offering even further. Competitors may attempt to challenge the incumbent firm, and as such, the firm should maintain a strong position, a strong bargaining power in relation to other ecosystem participants, including key customers and key suppliers.

Moore's (1993) final step of *self-renewal* entails the firm to work with the innovative members in the ecosystem in order to follow up previous innovative solutions with new ideas. At the same time competitive ecosystems may aim to do the same, and as such, it is critical for the focal firm to continue maintaining high barriers of entry to the market and maintain high switching costs to the customer to enable them to ensure more time for future innovations. Alternatively, Moore (1993) mentions that the ecosystem structure may die, due to more innovative solutions provided by alternative sources.

In his book, Moore (1996) extends the concept of the business ecosystem to consist of all the individuals, organizations, government entities, regulatory bodies the business interacts with, including customers, competitors, media, etc. and that the key of a successful business ecosystem is a mutually beneficial relationship between the participants. Moore (1996) also notes that business ecosystems often benefit from scale and most importantly from continuous innovation. Moore (1996) even goes as far to argue, that the competition among different ecosystems permeates what he aptly called stage-two competition. It should also be noted, that business ecosystems are not only built up from individual participants coming together, but also by ecosystems operating together, thus creating newer larger business ecosystems. Zahra and Nambisan (2012) note that interactions between business ecosystem participants reflect and even reinforce their co-specialization in different economic actions. However, these actions are often coordinated and organized by a central player in the ecosystem that provides different participants the incentives to co-evolve.

As the business ecosystem concept has been explained, per prior discussion, what about the innovation ecosystem concept, what are the distinctive factors to an innovation ecosystem, and how the definition changes when comparing the two different approaches?

In their article, Gawer and Cusumano (2014) elaborated upon the concept of "industry platforms" that form around innovations and their relation to managing innovation within and outside the focal firm. Gawer and Cusumano (2014) explain that these platforms are often associated with "network effects"; where the number of users that adopt the platform makes the platform more valuable to the owner and to its users, since the platform now allows for access to a larger network of users. This often leads to a growing set of complementary innovations within the platform attracting more users to adopt the platform, and as such, the platform's userbase, in theory, grows exponentially. However, in

practicality participants may leave the platform and join another due to innovative advancements or due to better network opportunities. Gawer and Cusumano (2014) explain that platforms have also been used in academic literature to describe markets with two or more sides, aptly named “multisided markets”. A “multisided market” constitutes a market where goods or services are provided to several distinct groups of customers, all of whom need each other in some way and rely on the platform to enable their transaction (Gawer and Cusumano, 2014). When a new industrial platform emerges, the position of industrial leadership is often contested and can be lost, as the balance of power between participants often changes. Conversely, new industrial platforms may facilitate and increase the degree of innovation between participants through new complementary products and services.

Suominen, Seppänen and Dedehayir (2019) argue that the term innovation ecosystem is used in ambiguous ways and that different authors have established similar systems on a corporate dynamics level based on innovation, such as clusters (e.g. Porter, 2004), value networks (e.g. Li and Whalley, 2002), innovation networks (e.g. Chesbrough and Rosenbloom, 2002) and business ecosystems (e.g. Moore 1993). Often different interpretations of the innovation ecosystem are used synonymously with each other resulting in a fuzzy concept.

Adner (2006) characterizes the concept of an innovation ecosystem by three fundamental types of risk that are present in relation to the markets the firm may hope to serve. First of these types of risks are *initiative risks,* these constitute risks drawn from familiar uncertainties from managing a project. Second risk type includes *interdependence risks,* risks caused by uncertainties in coordinating complementary innovators. And the third risk type includes *integration risks,* the uncertainties that rise from uncertainties in adopting innovations across the value chain. Adner (2006) points out that it is easy to overestimate the potential value creation associated with combining capabilities within an innovation ecosystem – as the focal firm cannot control factors affecting other ecosystem participants’ success.

Dedehayir, Mäkinen and Ortt (2016) refer to the innovation ecosystem as a heterogenous constellation of organizations that co-evolve their capabilities through co-creation of value. Mäkinen and Dedehayir (2013) found that among other organizations innovation ecosystems consisted of producers, suppliers, distributors, financial and research institutions, makers of complementary technologies and regulatory bodies (in Dedehayir,

Mäkinen and Ortt, 2016).This innovation ecosystem structure is illustrated below in figure 13.

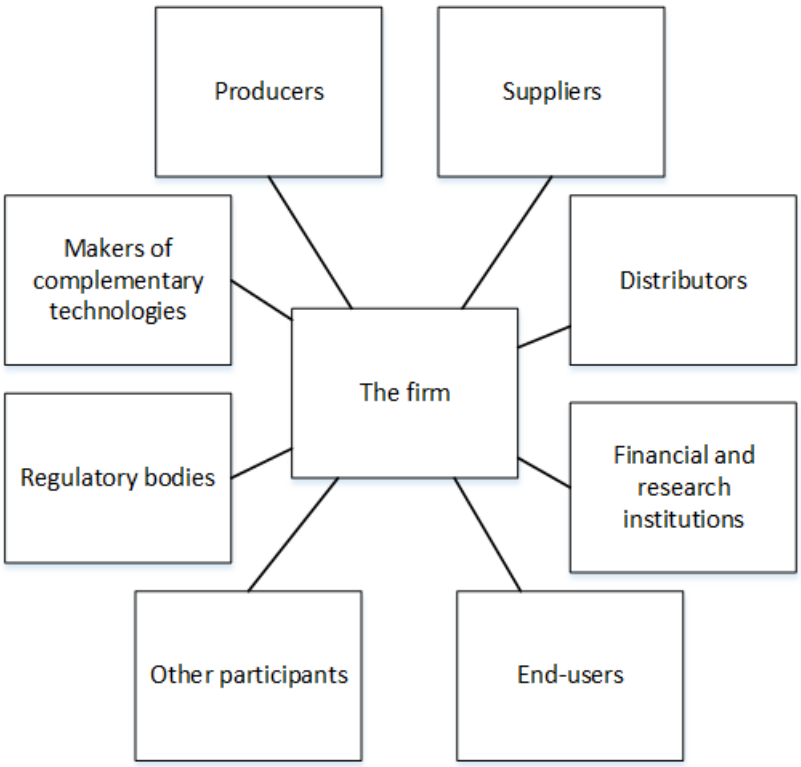


Figure 13 *Innovation Ecosystem, based on Dedehayir, Mäkinen, Ortt, 2016*

Dedehayir, Mäkinen and Ortt (2016) emphasize that innovation ecosystems do differ from value networks, in the sense that the innovation ecosystems resemble their biological origins in focusing on the co-evolutionary processes taking place as various organizations interact with each other, often through symbiotic relationships. Furthermore, the innovation ecosystem construct differs itself from other network structures by including end-users to the constellation.

In the context of this study, the view of innovation ecosystems being a somewhat abstract structure with often an N-amount of participants is adopted and the ecosystem evolution steps proposed by Moore (1993) are recognized. For the context of this study, it is important to understand the existence of these constructs, however, the study will not focus on exploring these concepts further.

2.3.2 Value generation in an innovation ecosystem

As the innovation ecosystem is understood as a rather abstract term to describe a group of organizations that co-create value, it is important to take a step back and understand how value is generated in a complex structure, like the innovation ecosystem and how the perception of value generation has changed. In strategic and in marketing literature, the concept of value often refers to the positive subtraction between the benefits the customer gets from buying the products, in comparison to the costs that are incurred from buying the product. Therefore, to increase the value of an offering the firm could either increase the benefits of the product or lower the costs of buying the product. Additionally, the concept of value is ultimately determined by the customer and not by the focal firm.

Importantly, this understanding of value paved the way for Porter's (1985) structure of the value chain, where the company creates value via what Porter would call value activities. In Porter's (1985) view of the value chain, the value the company made could be measured by the amount of buyers willing to pay for it. Thus, the value generated in a value chain would be equal to the price of outputs minus the price of inputs. Furthermore, for the business to be profitable, the value created had to overweight the costs of performing said value activity. This understanding of value chain often viewed the company as an individual entity and this understanding could be later critiqued through its understanding of firms operating in somewhat vacuum-like conditions. According to Suominen, Seppänen and Dedehayir (2019), the value chain is often characterized by a linear flow of value from raw materials to customers with discreet steps.

In the traditional understanding, the firm's competitive advantage was reliant on its ability to create more value than its comparatives, that being its rivals (Porter, 1985). Adner and Kapoor (2010) explained that the value creation of the firm was dependent on the firm's innovations. If the firm was able to innovate successfully, it could create value at a higher rate than its competitors. In their article, Normann and Ramirez (1993) aimed to extend the value chain to a larger framework, the value constellation, that would consider different entities interacting with the final product by adding value in non-sequential order. Normann and Ramirez (1993) argued that successful companies not only increase their value creation in their value activities, but reinvent value altogether.

The concept of value creation is often accompanied by the concepts of value delivery and value capture (as in Osterwalder's (2010) description of the business model), in a way that together explain how a firm creates and delivers value to its stakeholders and how the firm captures value from the value delivered. Adner and Kapoor (2010) explained that within innovation ecosystems the location of the firm affects how effective the firm can be in creating and capturing value and that the firm's ability to create value is heavily impacted whether or not it faces innovation challenges. Innovation challenges, even down- or upstream from the focal firm may affect its capabilities in value creation and capture. Contemporary business structures, where platforms are either open or closed, also significantly alter the firm's capability in value creation and in value capture. Chesbrough, Lettl and Ritter (2018) explained that value creation in an open innovation structure required firms to be open themselves in order to leverage the knowledge of a set of diverse contributors, whereas value capture necessitated a more protective approach.

Leminen et. al (2018) argued that within ecosystems value creation and capture could be conceptualized with four pillars: *value drivers, value nodes, value exchanges* and *value extracts*. The value drivers, according to Leminen et al. (2018) included the motivations of participants to generate value, to realize innovations and simply, to make money. These often include win-win type of relationships between stakeholders, and thus, incentivized all the participants to partake. Value nodes can be actors, activities, processes or networks of organizations that are linked within an ecosystem to create value (Leminen *et al.*, 2018). Value exchanges occur when an exchange of value happens within an ecosystem. This exchange of value can involve resources, knowledge and/or information and can be perceived as the most common form of value conceptualization involved in ecosystems. Finally, Leminen et al. (2018) described value extraction as an activity where an ecosystem participant extracts value from the ecosystem. To illustrate an example of value design in an ecosystem, the figure 14 is drafted. Figure 14, illustrated below, describes an example on how an ecosystem can be structured from a value perspective.

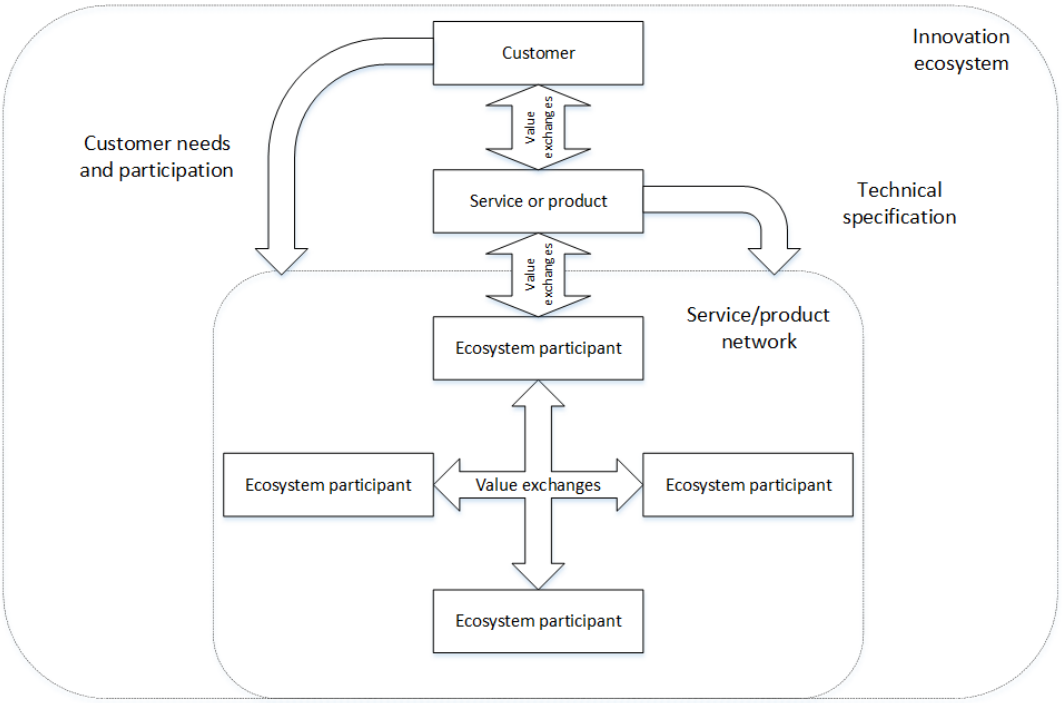


Figure 14 *Example of value in innovation ecosystem, based loosely on Leminen et. al, 2018*

In the figure above, ecosystem participants, within a service or a product network, exchange value between each other, eventually formulating a product or a service. Value exchanges keep occurring between the original network and the product or service post-exchange, and thus, the value does not remain constant through the use of the product or service. Similarly, the customer exchanges value with the product or service periodically. The customer also provides participation to help the network better suit the product or service to their needs. The product or service also provides the ecosystem technical specifications, which the network then aims to fulfil to the best of their ability.

In figure 14, the *value exchange* components are apparent, however *value nodes, value drivers* and *value extracts,* need further clarification. In the proposed figure above, according to Leminen et al. (2018), *value nodes* would include the ecosystem participants, the service or product, the customer and even the service or product network, thus making the concept of *value node* rather abstract and not too descriptive. It is, however, important to understand what is meant with a value node, as it may help some to understand the concept of an innovation ecosystem. The *value drivers* in this model could be the underlying reasonings why each participant is involved in the network, and how each participant is monetarily compensated at the end. The concept of a *value extract* is rather difficult to pinpoint. However, in the exemplary case of figure 14, a *value*

extract could be the customer that is extracting value from the use of the service or product. It is important to understand that in innovation ecosystems, participants can simultaneously extract value and increase value through value exchanges.

The example of figure 14 simplifies the construct of value generation in an innovation ecosystem in a sense that in this example each ecosystem member is focused on adding value through the product or service, whereas in academic literature ecosystems can be seen as systems that are not hierarchically managed and often have individual participants working towards their own goals rather than a common goal (Suominen, Seppänen and Dedehayir, 2019). This, in turn, does not infer that the goal cannot be shared among ecosystem participants and in practicality ecosystem participants may work towards reaching a common goal.

The key takeaway from this section of the study is the fact that understanding how value is generated differs greatly when moving to the realm of ecosystems as opposed to a traditional strategic view of a value chain. Value is often added to a product or a service while in use and this makes it more abstract to understand how value exchanges occur. Similar to how value is perceived in value networks, value exchanges can involve a conversion of intangible assets, e.g. knowledge into tangible outputs such as components, sub-assemblies or final products and services (Suominen, Seppänen and Dedehayir, 2019).

2.4 Synthesis of the theoretical background

In this subchapter a synthesis between prior subchapters is drawn. The subchapter includes discussions on the business model in the era of the Internet of Things, how the field of business model research has changed to reach this point and how one might approach business modelling in the age of industry 4.0. The subchapter also provides summarization of previous topics introduced in previous subchapters.

Academic research into the nature of business models and strategy could be put into a continuum, where early research in the topic aimed to identify singular determinants of competitive advantage and tried to attribute competitive advantage to distinctive features possessed by the focal firm. Competitive advantage was attributed to the firm having superior resources (Wernerfelt, 1984) or to the firm having superior positioning strategies (Porter, 1985). Both attributes lead to an extensive amount of research and development in their respective fields, the resource-based view spawned theories around knowledge

and information (e.g. Grant, 1996) and the positioning view expanded to a school of thought that academics and non-academics may recognize as porterian strategy.

Along this continuum, the advent of the dot.com era of the Internet facilitated studies into the field of dynamic capabilities, those being capabilities that made it possible to adapt to rapid changes in the market due to disruption or incremental technologies replacing older ones. Simultaneously, the concept of a business model raised interest as a topic for study and many business model studies were interested in understanding the components of what constituted a business model and more specifically, what made a business model successful. Early models of the business model were based on a limited number of components and it could be argued, that most of the early models only focused on areas each individual author valued. Even to this day, there is a lack of a universal business model, a model that would ground the field of study to a single set of components and focus points. Where early business model interpretations could be critiqued for their lack of components and gaps in portraying the firm, more contemporary models are often critiqued for the fact that they often do not leave anything out. Due to many industries driving firms becoming more and more interconnected, many business model constructs moved towards a networked approach, where business models no longer saw the firm in the zenith of their environment, but rather as a part of a larger construct.

Continuing on this continuum, the field of business model and strategy research expanded into fields of ecosystems and platforms. These ecosystems and platforms made it significantly more difficult to understand and more difficult to pinpoint the value proposition of each individual company, and these frameworks often saw the company as a part of a larger collective, offering value as part of the collective. This inevitably raises the question of how the firm should design their business models to fit the landscape of the Internet of Things. Westerlund et al. (2014) explained that designing business models for the context of the Internet of Things (referred to as IoT from now on) pertains certain challenges. However, it is increasingly clear that a business model designed for the IoT should be anchored in network thinking and value co-creation.

IoT business models have seen a significant amount of study in both forms, empirical (e.g. Fleisch, Weinberger and Wortmann, 2014; Silva and Maló, 2014; Ju, Kim and Ahn, 2016) and academic (e.g. Westerlund, Leminen and Rajahonka, 2014; Dijkman *et al.*, 2015; Metallo *et al.*, 2018). Westerlund, Leminen and Rajahonka (2014) quickly point out that to address challenges that arise from the ecosystematic nature of the IoT enable

increased customer orientation of the business model. This, in essence, means a shift from focusing on the individual firm's goals to a more comprehensive model considering the goals of the ecosystem. Westerlund, Leminen and Rajahonka (2014) suggested building a business model around the concept of value in which all parties provide for and benefit from the business ecosystem. This is a novel way to look at the business model in a more comprehensive light. However, in practice, it fails in its practicality for use.

Dijkman et al. (2015) noted that the field of IoT business models is still relatively unexplored, and that existing models in the field lack empirical validation. Dijkman et al. (2015), in their empirical part of their study, found that when constructing IoT business models, the concept of a value proposition can be seen as significantly more important than other areas of the business model. To an extent, this reflects the idea of value becoming more fragmented in the ecosystems of IoT. Thus, making it significantly harder to determine what the firm's role in value design should be.

Metallo et al. (2018) emphasizes the need for innovative business models in the era of Internet of Things, by explaining the huge potential that lies within the application of IoT ready devices. Metallo et al. (2018) noted that the concept of the business model could be perceived as a mechanism that connects firm technology and customer needs, resulting in a situation where the firm would be unable to exploit the inherent value potential embedded in these new technologies and convert said value to market outputs. Metallo et al. (2018) recognized the ecosystematic nature of IoT business models and described that platforms were serving as mechanisms to facilitate access to external resources. Metallo et al. (2018) extended this line of thinking by characterizing an ecosystem as a system of synergistic business models. If this line of thinking would be followed, the business model of the firm should consider the business models of its ecosystem, including customers, suppliers, etc.

Kiel, Arnold and Voigt (2017) noted that the intensity of integration efforts in integrating the IoT into the value creation of the firm would have significant effects in previously established business models of the firms. Kiel, Arnold and Voigt (2017) noted that value offers, through the use of the IoT, could be characterized by the provision of highly individualized products, advanced mass customization and batch size one production. A highly specific value offer in this case would lead to extensive interactions between the firm and the customer leading to a significantly intensified customer relationship. Kiel,

Arnold and Voigt (2017) also explain that the IoT facilitates a new form of customer relationship, one that is characterised by direct communications to the end-customer. This type of business-to-business-to-customer relationship on the other hand has its own challenges as the business model should be adapted in a way that suits both the intermediary customer and the end customer.

Exploratory studies in the field of Internet of things business models have elaborated upon the fact that the IoT provides interesting new avenues for increased profitability with companies' solutions. As an example, Rymaszewska, Helo and Gunasekaran (2017) concluded that the use of Internet of Things solutions could boost servitization initiatives within a company's portfolio, and thus, lead to increased profitability. Furthermore, Allmendinger and Lombreglia (2005) concluded that adding 'smart services' around the firms offering may help organizations escape commoditization of their product lines. Thus, adding services around the focal offering of the firm may also prove itself as a strategic response in order to keep the product mix competitive. Additionally, Rymaszewska, Helo and Gunasekaran (2017) found that Internet of Things-based solutions offer a way for companies to craft their value propositions in a way that can move companies closer to their end customers.

However, conversing studies into deservitization have also gained significance within Internet of Things business models research. As an example, Valtakoski (2017) concluded that empirical evidence has shown that many firms with servitization initiatives have found themselves with decreased profitability and failed attempts of value proposition expansion. Valtakoski (2017) elaborates that reasons for this are many, as companies may fail their servitization attempts due to, for example, the value offered being too low for customers, or due to customers having better knowledge on the components or due to having lacks in competence in codifying and transferring knowledge collected from the IoT sensors that are in use. Kowalkowski et al. (2017) had coined a term for lacking performance in servitization initiatives aptly named the 'service paradox', where investments in service growth fail to generate corresponding returns or shareholder value. Kowalkowski et al. (2017) did recognize that there are opportunities in offering an extended service offering, however, they concluded that the servitization-deservitization dynamics are not yet understood well enough and require further research.

This study recognizes the inherent flaws and gaps in business model research and acknowledges the fact that there is no universal design, when it comes to the business model structure. The concept of a business model is heavily tied with the capabilities of

the focal firm, and thus, the concept sees capabilities as a facilitator for novel business model designs. It should be noted, that many business model designs are routed in prior research in strategic theory, e.g. the resource-based view and thus the interconnective nature of capabilities and the business model may be a cyclical one, where both depend reflect on the other.

The introduction of different types of ecosystem structures and their link to business model design has put extensive pressure to established business models and has driven business model design to a more abstract level. A common critique levied at contemporary business model design is the fact that the design aims to include everything the firm does, and to include every connection linked to the firm leading in a lowered universality of the model.

The immediate effects of current development in Internet of Things have been recognized in business model design. However, challenges raised by the inclusion of IoT have yet to be answered. The fragmented nature of value creation has made business models even more abstract and forced companies to evaluate the network effects of their business models.

3. CONDUCTING THE RESEARCH

In this chapter the research methodology and the way the study was conducted are explained. The study design incorporated both, a literature study and an empirical study and this chapter aims to explain how each of those parts were constructed. The empirical part of the study incorporated semi-structured interviews and a questionnaire to find out what kind of adaptions should be made in business models in the Internet of Things context. This chapter also explains how the data was collected and describes the nature of study through reflecting on established research methods. Finally, this chapter concludes with an explanation on how the data for this study was analysed.

3.1 Research methodology

This study adopts the design science methodology, proposed by March and Smith (1995) as a foundational starting point, and as such the main goal of the study is to create conclusions that serve human purposes, conversely to social and natural sciences that try to understand the nature of reality (Au, 2001). As such, the validity and significance of the outcomes of this study can be understood by their utility in practice. In this study, parallels are drawn between the capabilities approach, the business model approach and the ecosystem approach and through exploring the relationships between these three, as one of the academic goals of this study. Understanding the changing landscape of research into concepts such as the business model and the ecosystem enables evaluation of potential sources of competitive advantage in business model design in the everchanging landscape of the IoT. This was accompanied by an empirical study into a case company that had elements in both qualitative and quantitative research.

This study adopts the pragmatic research philosophy proposed by Saunders, Lewis and Thornhill (2009) that outlines the main drivers for this study as

- *Design Science:* Pragmatic research philosophy offers the greatest likelihood to generate practically useful research products
- *Multi-method:* The multidimensionality of the phenomenon necessitates both qualitative and quantitative analysis

Saunders, Lewis and Thornhill (2009) also note that the researcher cannot be purely objective in his view of the company, if the researcher is personally involved with the business. This study also adopts Gummesson's (1993) categorization of different data gathering methods and, thus, separates different data collection methods into five different categories. Gummesson (1993) identified the following methods for data collection, illustrated below in table 5.

Table 8 *Data gathering methods, adapted from Gummesson, 1993*

Method	Description
Literature review	Use of existing materials, books, articles, journals etc.
Survey	Structured and standardized questionnaires
Interview	Semi-structured or open questions presented to the subject
Observation	Non-participatory observation of the study subject
Action science	Full involvement from the researcher, may include all other data gathering methods simultaneously

Due to nature of the study, a multi-method study design was adopted combining a literature review, a survey questionnaire and a semi-structured interview. Some of the choices were made to suit the needs of the case company. The study design offers a cross-sectional horizon to the studied topic, as the focus of the study is to find out the state of the topics as they are per-now. According to Saunders, Lewis and Thornhill (2009) this constitutes a cross-sectional horizon, as the research is focused on a particular time frame. As the researcher is currently employed by the focal firm, it could be argued that the study also incorporates some action science elements. Daily involvement with the focal firm has also arguably made the researcher uniquely qualified to evaluate the current topics of the study.

3.2 Data collection

Data in this study was collected through a literature review, through semi-structured interviews and through a survey questionnaire. The literature review conducted, provided a basis for evaluating the relative importance of business model components in the future (in particular with Internet of Things) and a basis to understand how capabilities are intertwined with the concept of the business model. Thus, enabling the researcher to suppose hypotheticals about the relative importance of business models in the future. The

literature review conducted, adopted a snowball methodology, where the search approach used the reference list of a paper or citations within a paper to identify additional papers (Wohlin, 2014). For the literature review, the process of data collection was adaptive, according to a study design proposed by Yin (2017). This meant that new data was added to the scope of the study as it became necessary. Based on a preliminary set of assumptions, a set of semi-structured interviews were conducted to verify the literature review's results.

Previously mentioned interviews are later discussed in more detail in the next subchapter. Overall, there were four interviews conducted, a sample that included three subjects that operate within the topic's realm on a daily basis through empirism, thus, considered experts in practicality in the extent of this study, as the field of IoT is still relatively young. The final interviewee was from an academic background, providing a different perspective to balance empirical findings. Each of the practical experts interviewed represented different industries with highly varying industry characteristics. First interviewee represented an industry defined by high capital expenditures into heavy machinery, where the lifecycle of a machine can be extended far into the future and where the machine purchases were often made by larger companies. Conversely to the first interviewee, the second interviewee represented the supply side of IoT network business, making it possible for complex systems to transfer data from one place to another. Additionally, the second interviewee represented a company that operates in both business-to-consumer and business-to-business. The third practical expert represented an industry where capital expenditures are significantly smaller and an industry where the customer base is more fragmented consisting of individual customers, midsize companies and larger companies. The selection of interviewees was aimed to give a broad perspective on different organizations operating under different day-to-day drivers, providing different perspectives to the topic at hand. The average length of these interviews was 43 minutes, without the inclusion of the introduction phase of the interview and without the break in the middle of each interview (only held at interviewee's request). The interviews were all conducted face-to-face in Finnish.

After verifying the results of the literature review through semi-structured interviews, the study continued with a questionnaire survey, sent out via email to a sample set chosen by the case company. The participating companies operate in the ecosystem of the case company and, thus, the results of the survey could be found to have significant importance to the case company. Similar to the interview, the questionnaire is also explained in more detail in the next subchapter.

To incentivize answers and to ensure a wide enough basis for statistical analysis, the questionnaire was designed as a rather simple one with 12 main questions separated under 3 different topics. The survey was sent out to 146 pre-chosen participants of which 67 filled out the survey. This constituted a completion rate of 45,89 percent of the sample set. This establishes statistical significance, as web surveys often lead to lower response rates than other forms of surveys due to several challenges (e.g. limited web literacy) they have to overcome (Manfreda *et al.*, 2008). Manfreda et al. (2008) also noted that web surveys can often be perceived as impersonal or as less legitimate, and, as such, to overcome these challenges the researcher sent out the survey link to each participant from their own personal email address, provided by the case company.

3.3 Methods of analysis

This study included a literature review and a case study, where data was collected with semi-structured interviews and a survey questionnaire. In accordance to Saunders, Lewis and Thornhill (2009) a literature review was conducted to familiarize the researcher with the topic, as to help the researcher come up with research questions and to allow the researcher to have a better understanding of the researched topic and its position in a bigger picture. The literature review was based originally on the Web of Science and Scopus databases, where papers around topics were listed in order of times cited. After the initial search of journal articles and books the study adopted a snowball methodology, where additional articles, books and conference papers would be collected from the citations of the prior articles already collected, following a study design introduced by Wohlin (2014).

The case study consisted of semi-structured interviews and a survey questionnaire. The interviews conducted were recorded at the time and later anonymised and transcribed to text files. The interviews were originally conducted in Finnish to aid the discussion about the topic that is rather new and to help the interviewees express their thoughts on the topic. Due to the difficult nature of the topic, an interview conducted in a non-native language could have posed issues in detailing the topic at hand. After transcribing the text files were read in detail and the content was divided into thematic groups and then translated in to English. To an extent, this may pose a challenge to the study's findings, as there is potential for bias and misinterpretation from the researcher's part as the content is both divided into subgroups according to their themes and then translated. Choi et al. (2012) pointed out that a challenge in language translation in these types of

cross-language studies is in that the translators need to be, both fluent in the language and understand the cultural expression embedded, to produce meanings-based translations rather than word-for-word translations. However, Choi et al. (2012) also conclude that if the translator and the researcher (in the context of this study these both are the same) are familiar with the study participants' culture and language, this will lower the potential threats that may question the validity of the data collected.

Each of the interviewees received the interview questions in advance in Finnish, to allow familiarization of the topic beforehand. The interviewees were chosen through pre-existing contacts and were chosen as IoT representatives of their respective companies. The interviewees were selected from industries and companies that are not directly in competition with the case company to limit the reasons for the interviewees to withhold information relevant to the topic. The interviews conducted resembled informal discussions around the topic and aimed to arrive to new and surprising notes about the topic in question. The interview structure (appendix C, translated in to the English) was first piloted with an internal interviewee in the case company to make sure that the interview would consist of questions that are both understandable and would allow for further discussion. Slight adjustments were made to the interview structure after the pilot interview due to some questions being hard to comprehend.

After the interviews were conducted, a questionnaire survey, based on the results gathered in the literature review and the interviews, was drafted. Similar to the interview itself, the survey was sent out to study participants in Finnish, in order to lower possible language barriers in the participatory role. The survey followed a hypothetical model, that was later used as a framework for analysis (appendix D), on which the analysis was built upon. The survey structure (appendix E) consisted of a short contextualizing part of the respondent's background and the main questionnaire part, consisting of 12 arguments about and related to the topic of Internet of Things. Responses to each argument were given according to a four-point Likert scale. The Likert scale was designed in accordance to Lozano, García-cueto and Muñiz (2008) who concurred that the ideal amount of categories in a Likert-type format, for study reliability and validity, would be between four and seven categories. An even number of Likert categories was chosen, as according to Lozano, García-cueto and Muñiz (2008), the existence of the 'middle option' could skew the results and would enable some respondents to not take a stance on the matter.

The survey results, once collected, were gathered and analysed statistically. The response rate of the survey, at 45,89 percent, established a statistical significance and can

be thus considered as a representative sample of the entire sample set of the potential respondents. The surveys were sent out to managers of their respective organizations and there can be arguments made for the difference between what the managers' personal opinions and what the day-to-day activities around the topic are.

Overall, the reliability of the results could be critiqued, as respondents may have given a more positive outlook on their current state, as to better fit an inferred target state. The participant organizations might be uncomfortable giving honest performance related answers to a researcher, who, in essence, is representing the case company in this study design. The empirical portion of the study focused solely on Finnish market and would provide interesting potential for extension to cover a global landscape.

4. ILLUSTRATING EMPIRICAL RESULTS

In this chapter, the results of the empirical part of the study are presented. The aim of this chapter is to mainly present the results and to provide only limited discussion. In the next chapter, chapter 5, the results are discussed in more detail and are reflected upon in accordance to existing literature and the original research questions of the thesis. Citations from the interviews are presented in this chapter. However, they are translated from Finnish to English, to accommodate the language of the thesis. The translations are made through meanings-based translations and as such there are some possible pitfalls and challenges in the representativeness of the citations given. The citations in this chapter are marked by presenting them in *italics.*

The focus of the empirical part of the study was in the transformative nature of the Internet of Things (IoT) to the capabilities required to stay competitive and how the nature of competition would change with the advent of IoT. Also, considerations into how the advent of the IoT changes business models were raised and current adoption rates were estimated. The shift to a more networked business model approach was also raised during the empirical study. The results gathered are utilitarian by nature.

4.1 Context of the Study

Different firms may have different motivation factors and different approaches when it comes to adopting the Internet of Things. Many firms have taken the initiative to move towards incorporating IoT into their business, whereas others may have been forced to do so. While some may even disregard the prospects entirely, as they see no potential in the development of IoT within their industry. The market potential for Internet of Things related or based solutions has been estimated to be in the realm of hundreds of billions, and as such many practitioners see strong motivations to move towards a more IoT based business model.

4.1.1 Differences in the role of firms and their effect on Internet of Things adoption

Before illustrating the results of the empirical portion of the study it is important to understand how different circumstantial differences can affect the perception of the Internet of Things (IoT). Firms often differ from each other, not only by their resources and capabilities, but also by their goals and aspirations. Most notable differences between firms and their approach to the Internet of Things could be interpreted from their:

- Industry and their role within that industry
- Phase of the firm's Internet of Things adoption
- Network/ecosystem role
- Prior knowledge and approach to the Internet of Things

During the interviews it became readily apparent that the approach to IoT could be vastly different due to underlying conditions of the firm. Interviewees were asked questions about their perspective on where the IoT development would be going and also on their understanding of how IoT would change the established business models of established firms. Although the interviewees were told beforehand that the results would be anonymised, several of their answers reflected their firm's current projects and challenges they've been facing within the realm of IoT.

The first differentiator between firms was perceived to be their industry and the respective role of the company in the industry. If the firm operates in an industry characterized by massive investments, the nature of IoT-based offerings shifts towards IoT-enabled maintenance plans, where firms aim to gather and utilize data to enable more involved after-sales activities. This contrasts some predictions made about IoT enabling and moving manufacturing more towards Service-level agreement contracts (SLAs) where the focal firm sells outcomes rather than capital goods. Data gathered on the field could also provide the firm opportunities in 'optimizing' the quality of the capital good, thus, foregoing the production of 'over-quality' goods. One interviewee described this in effect by saying:

… if we were to sell our solution based on a monthly-revenue stream, no one would start using it […] our customers are accustomed to comparing the price of our machine to other machines.

However, the same interviewee described IoT-enabled opportunities elsewhere in production design followingly:

… we now know how our machines are used and we can design our machines […] to the conditions so that they will work optimally.

Industry conditions may vary significantly, however, where some industries are extremely forward-looking into novel revenue models and see customers demanding revenue models that do not include capital expenditures. The firm's relative power over the industry may also affect their approach to IoT, as one interviewee put it:

… if the big players decide that they want to pay for a cubic meter of (unit of measurement in the particular industry) *[…] these big players no longer want to own the machines […] a large deal may be surprisingly interesting still.*

Thus, in an industry with powerful customers some firms may be forced to change their revenue models to ones incorporating IoT-enabled solutions.

Second differentiating factor was the phase of the firm's Internet of Things adoption. Some companies may already have a project in development that incorporates IoT elements in its design and, thus, have invested significant research and development into the field, whereas others may only have started working on the field. One interviewee explained:

… During the past two years we have been thinking how the IoT could benefit our maintenance activities […] now we're more and more interested in what else could be achieved with IoT.

Third differentiator between companies was their role in their ecosystem/platform. The advent of the Internet of Things has blurred the lines of value creation within these types of network structures and as mentioned in the existing literature, these network structures have different types of roles for different organizations. Some may operate as system integrators controlling and administrating activities within the network whereas others may operate in a small niche within the system. As one interviewee put it:

… customer may want to buy from one seller […] the seller does not do everything but divides the tasks and outsources them.

Finally, prior knowledge about the Internet of Things could also differentiate results between respondents. In the survey part of the study, out of the 67 respondents, 41 (61%) were familiar with the fairly common examples of Internet of Things-enabled solutions. Respondents less familiar with the subject may have their reservations about the subject and may hold hesitant views on the usefulness of IoT applications or may hold cynical viewpoints about the market potential that lies in the development.

4.1.2 Motivations for adopting Internet of things

The Internet of Things saw its biggest growth spurt at the turn of the 2000's to 2010's, as many companies operating in the space appeared, in what seemed like overnight. There are different motivators, some previously mentioned and some not, that may drive firms to adopt IoT in their business models and drive development forward. Most notable motivational factors identified in the study were:

- The firm's appearance as an innovative company
- Customer needs and potential for increased customer value
- Financial motivations

One of the key motivating factors that was raised in the interviews to adopt the Internet of Things to the firm's business models was the firm's appearance as an innovative company. One interviewee explained the situation followingly:

When we consider a small percentile of our customer base that want to be on the edge of development […] those that have something concrete to show have an advantage […] we have won deals with our IoT solution.

You can go to a firm ten times as big […] they are still not even close where we are in terms of development.

Thus, the appearance of innovativeness has benefits that are two-fold, some affect the public image of the company and raise visibility, whereas others may directly provide the firm competitive advantage. The benefits in public image and raised visibility may

also attract potential high-skill workers to join the company and, thus, allowing the company to develop its offering even further.

Some interviewees explained that a significant motivator for adopting Internet of Things to their business models is (or could be) customer needs. The market pull for these types of solutions may drive towards incorporating Internet of Things elements to the firm's business model. However, these elements may also be added due to a technology push reason with an aim to increase customer value. Interviewees explained the concept followingly:

We can suggest upkeep activities to customers […] we provide pre-emptive maintenance

Customers do not necessarily demand to know how long a component lasts or what the current condition is […] customers demand lower lifetime costs […] we can offer mechanical upkeep.

With the data collected from the sensors equipped in machinery, firms can offer the customers added value e.g. in the form of maintenance. Added value is one of the key sources of competitive advantage and as such, the creation of added value can provide the firms significant edge in the market.

Eventually, all potential motivators seemed to lead to the central motivator along the landscape of IoT. All interviewees pointed out the potential financial benefits from adopting IoT in to their business model and explained how they've had projects and/or investments made in the area. The financial aspects were divided into two main drivers: lowering costs to customers and increasing revenue. Increased revenue could be found through either novel pricing structures or through increased after-sales activities. However, the emphasis in the interviewees' answers seemed to favour the cost lowering side of things.

4.2 Survey questionnaire results

To under the possible challenges and pitfalls involved in Internet of Things business model design and in the business network structure that is highly related, a survey was conducted to better understand the current situation. Based on the literature review and

based on the expert interviews conducted, four hypotheticals were made to which a survey structure would be built upon:

- The firms within the case company's network would consider their expertise in Internet of Things solution delivery to be limited
- The perceived potential in business model expansion would be fragmented within the network
- Some customers are expecting more comprehensive solutions, and
- Differentiating competence factors could affect the nature of competition within the network.

Based on these assumptions a framework for analysing the current situation (appendix D) was drafted. The framework hypothesized that the amount of sales of IoT-enabled solutions for each individual respondent would be correlative with their information and communications technology competence and the market readiness for the solutions. A third element regarding the intensity of competition was added to the framework as the market readiness for IoT solutions would drive up the intensity of competition in the field resulting in the need for ICT capability development. These objectives for the survey thus became:

- To evaluate the current state of ICT capabilities
- To evaluate the market readiness for IoT-enabled solutions, and
- To evaluate the perceived level of competition

Based on these survey objectives a survey questionnaire was drafted. The survey adopted each of the objectives as key topics and included four questions under each topic. The survey questionnaire also included a brief part that surveyed the background information about the respondent's company. Additionally, the survey collected data on how familiar the respondents were with basic level IoT applications (an activity tracker or a smart bulb), after which a short description was given about the Internet of Things as a concept, to develop a suitable mindset for respondents prior to any answers given.

The survey questionnaire consisted of 12 questions divided into the three previously mentioned topics, which were presented four at a time, to ensure not overwhelming the respondent with statements. The survey took place over a four-week time period, where the respondents were sent out the survey link a total of four times. Responding to the

survey was incentivized with a raffle among respondents, which could put the results under scrutiny.

The response rate of the survey was 67 respondents out of a 146-sample size, constituting a percentual rate of 45.89 percent. The respondents' company size, represented by the number of employees, can be found below in figure 15.

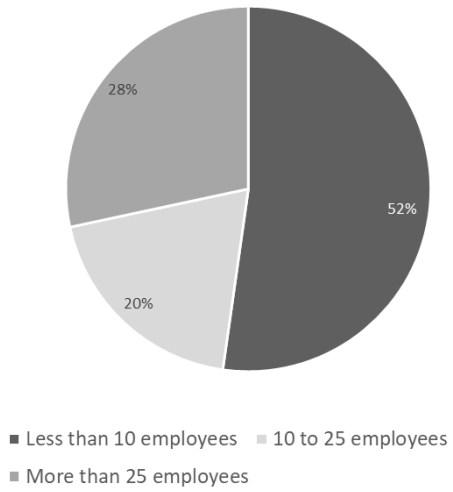


Figure 15 *Respondents' firm sizes by the number of employees, percentual*

As stated previously, the survey reached a total of 67 respondents, divided into three main groups by firm size. The majority (52%) of the respondents reported their firm size as less than 10 employees, a fifth reporting their firm size as being between 10 to 25 employees (20%) and the remaining respondents reported their firm size as being more than 25 employees (28%). The size of the firm has significant impact in the resources employed and the resources available to the firm, and as such, it poses great significance to understand what the composition of the respondents are. Measures taken, based on the results collected, may vary due to firm size as well, and as the majority of respondent firms lean to the smaller size, this should be especially considered.

The operating environment, of the firms studied, lies within the industry of a human-built environment. As mentioned previously, the industry can affect adoption rates of IoT solutions significantly and the industry in question can be characterized by resistance to

change (e.g. Gambatese and Hallowell, 2011). However, some academic literature argues that some industries may be more innovative in other areas than other industries, which causes said industries to appear to be lagging behind, while in practice not doing so (e.g. Winch, 2003).

Understanding the context and the background of the survey, results can be elaborated upon in accordance to the framework applied. The survey results will be divided into three subchapters, in accordance to the topics previously mentioned.

4.2.1 Information technology competence

The first area of the survey focused on the information and communications technology competence within the case company's network, to understand the current status of capabilities present, and to understand if there is initiative within the network to develop these capabilities to be able to respond to future market needs. The survey questionnaire identified four ICT capabilities metrics that were studied, first being the perceived role of these capabilities in the future for the case company's industry. Second dimension being the perceived current status of the capabilities within the organization. Third dimension being the utilization of these capabilities to generate other revenue streams in the form of service offerings and, as such, this measuring the organizations' future goals in expanding their service offering in the following five years. Finally, the last measure studied was the respondent's approach for developing ICT capabilities and how consistently this would be done to answer possible future challenges within ICT. Table 6 shows the number of occurrences for each answer divided into subgroups according to company size, the letter 'S' notating for smaller, sub-10 employee companies, the letter 'M' notating for medium sized companies, in the 10 to 25 employee range and the letter 'L' notating for larger sized, over 25 employee companies. These occurrences are then added up and a mean average that is bolded for each answer is calculated.

Table 9 *Survey results: ICT capabilities, number of occurrences, accumulated*

N=67	Strongly Disagree (1)	Somewhat Disagree (2)	Somewhat Agree (3)	Strongly Agree (4)	Aver-age
S (1.) ICT capabilities will play a significant role in the future in installing industry products.	0 (0%)	2 (6%)	18 (51%)	15 (43%)	**3,37**
S (2.) Internally, I feel like we have the required knowhow necessary for delivering Internet of Things solutions to customers.	1 (3%)	8 (23%)	17 (49%)	9 (26%)	**2,97**
S (3.) Our goal is to expand our service offering in the following five years.	0 (0%)	0 (0%)	20 (57%)	15 (43%)	**3,43**
S (4.) To avoid future challenges, we continuously develop our ICT capabilities.	0 (0%)	1 (3%)	23 (66%)	11 (31%)	**3,29**
M (1.) ICT capabilities will…	0 (0%)	0 (0%)	3 (23%)	10 (77%)	**3,77**
M (2.) Internally, I feel like…	0 (0%)	3 (23%)	8 (62%)	2 (15%)	**2,92**
M (3.) Our goal is to…	0 (0%)	0 (0%)	4 (31%)	9 (69%)	**3,69**
M (4.) To avoid future…	0 (0%)	1 (8%)	7 (54%)	5 (38%)	**3,31**
L (1.) ICT capabilities will…	2 (11%)	1 (5%)	8 (42%)	8 (42%)	**3,16**
L (2.) Internally, I feel like…	0 (0%)	6 (32%)	9 (47%)	4 (21%)	**2,89**
L (3.) Our goal is to…	2 (11%)	0 (0%)	4 (21%)	13 (68%)	**3,47**
L (4.) To avoid future…	1 (5%)	1 (5%)	8 (42%)	9 (47%)	**3,32**

Table 6 shows that ‘medium’-sized companies are the most likely ones to predict that the industry is going through a change towards a more interconnected ICT-enabled direction, where ICT capabilities will play a significant role in the companies’ core activities. Additionally, table 6 shows that ‘larger’-sized companies are the most hesitant to predict disruption in this sense, with a percentual 16% disagreeing strongly or somewhat with the statement ‘*ICT capabilities will play a significant role in the future in installing industry products*.’

Surprisingly, even with ‘medium’-sized organizations, predicting a significant increase in the role of ICT in the industry, respondents in these organizations were the most hesitant ones to strongly agree with the statement that their internal capabilities are at a required level for providing Internet of Things-enabled solutions to customers, with only a percentual 15% agreeing with the statement strongly.

Across all responses, there was a significant emphasis on the fact that the respondent companies were aiming to increase their service offering within the next five-year span. This may be a reflection on the direction of the industry or may indicate a significant shift in these companies moving towards a more service-based solution portfolio.

Overall, the responses indicate a high significance for ICT competence going in to the future. This may be due to the nature of the industry facing disruption in the products offered or may be due to customer demand in the industry. To reflect on the results gathered on the ICT capabilities, the next subchapter considers the market readiness for interconnected products utilizing a higher level of IT components.

4.2.2 Market readiness

In accordance to the framework set out for the survey, the second area studied was the market readiness for more comprehensive solution offerings. The survey questionnaire posed this area as the perceived customer demand and readiness for new products within the market, as opposed to analysing absolutes. Similar to the previous area of ICT capabilities, the survey questionnaire found four dimensions in which the market readiness was measured. The areas considered included customer needs for a more comprehensive security solution and/or additional services around the installation of an industry product. The latter part viewing the market readiness for these types of offerings more broadly, while the prior looking at the issue directly from a security perspective. Additionally, the perceived value addition of combining Internet of Things components to the solution was measured to understand the approach the case company's network has towards IoT-enabled solutions and to understand, how they perceive the market. Finally, the survey questionnaire aimed to find out if the customer needs were developing faster than the value offered could to find out if the industry was lagging behind customer needs or if the industry was staying up-to-speed with the end customers. Similar to table 6, table 7 illustrates the accumulated results gathered, divided similarly to subgroups and presents calculated averages for each of the statements.

Table 10 *Survey results: Market readiness, number of occurrences, accumulated*

N=67	Strongly Disagree (1)	Somewhat Disagree (2)	Somewhat Agree (3)	Strongly Agree (4)	Aver-age
S (5.) Customers wish for more comprehensive security solutions, in comparison to what was previously available.	0 (0%)	1 (3%)	23 (66%)	11 (31%)	**3,29**
S (6.) Internet of Things solutions offer increased value to end customers.	0 (0%)	3 (9%)	24 (69%)	8 (23%)	**3,14**
S (7.) Customer needs develop faster than the customer value that can be offered with the current product line-up.	1 (9%)	16 (46%)	15 (43%)	3 (9%)	**2,57**
S (8.) End customers wish for additional services around the basic installation of an industry product.	0 (0%)	7 (20%)	18 (51%)	10 (29%)	**3,09**
M (5.) Customers wish for…	0 (0%)	0 (0%)	9 (69%)	4 (31%)	**3,31**
M (6.) Internet of Things…	0 (0%)	0 (0%)	4 (31%)	9 (69%)	**3,69**
M (7.) Customer needs…	1 (8%)	4 (31%)	6 (46%)	2 (15%)	**2,69**
M (8.) End customers wish…	0 (0%)	3 (23%)	6 (46%)	4 (31%)	**3,08**
L (5.) Customers wish for…	2 (11%)	0 (0%)	7 (37%)	10 (53%)	**3,32**
L (6.) Internet of Things…	1 (5%)	2 (11%)	9 (47%)	7 (37%)	**3,16**
L (7.) Customer needs…	1 (5%)	4 (21%)	9 (47%)	5 (26%)	**2,95**
L (8.) End customers wish…	2 (11%)	1 (5%)	8 (42%)	8 (42%)	**3,16**

Table 7 indicates that ‘medium’-sized businesses within the case company’s network are the ones that have the most positive view towards Internet of Things solutions adding value to existing offerings. Additionally, ‘small’- and ‘medium’-sized organizations believe that the current offering cycles answer customer needs at a satisfactory rate with 55% and 39% disagreeing with the statement ‘customer needs develop faster than the customer value that can be offered with the current product line-up’ respectively. This could indicate that the ‘small’- and ‘medium’-sized organizations are less forward looking in their perception of the customer base. However, when the answers are reflected upon to the previous area, regarding ICT competence, the perception changes to a more positive view on how the manufacturers is performing with its development.

As could be expected, based on the prior results, the ‘large’-sized organizations could be seen as the most unsure ones in their perception of future market needs. However,

the contrast between ‘larger’ and ‘smaller’ organizations is significantly smaller in this part of the survey than it was in the topic prior.

Overall, table 7 indicates a notable market need for services around the current offerings the respondents’ organizations currently provide. To an extent, IoT solutions can be seen as a possible enabler for these types of services. However, these results are correlative and not causative. To put the previous results in to context, the final area, intensity of competition, of the survey questionnaire is illustrated in the next subchapter.

4.2.3 Intensity of competition

The final area of the survey questionnaire regarded the perceived intensity of competition faced by each of the organizations within the case company’s network. In accordance to the framework established, intensity of competition should rise as the market demand for new and innovative products increases and as intensity of competition increases the pressure to develop internal capabilities should rise as well. Similar to the previous two areas, the survey questionnaire measured the intensity of competition through four dimensions, in specifically related to providing Internet of Things solutions and to understand how the market is perceived by each respondent.

Three of the four dimensions considered, directly measured the specific context of IoT, where the first one of these statements measured how the competition was perceived within the realm of Internet of Things right now, and the follow-up statements evaluated the resources and capabilities the respondents had at their disposal to answer the competition that was currently present. The final dimension of this area of the survey questionnaire evaluated the perception that each of the respondent had about what size their competition was, contextualizing if sheer size benefits were perceived to play a role in competitive advantage within IoT solutions. Similar to the previous two tables, table 8 illustrates the accumulated results in regard to perceived intensity of competition divided into subgroups by firm size and presents calculated averages for each of the statements responses.

Table 11 *Survey results: Intensity of competition, number of occurrences, accumulated*

N=67	Strongly Disagree (1)	Somewhat Disagree (2)	Somewhat Agree (3)	Strongly Agree (4)	Average
S (9.) There is considerable amount of competition in delivering Internet of Things solutions to customers.	1 (3%)	4 (11%)	24 (69%)	6 (17%)	**3,00**
S (10.) Our competitors are larger companies than our company.	0 (0%)	3 (9%)	15 (43%)	17 (49%)	**3,40**
S (11.) Our competitors have better resources for delivering Internet of Things solutions than we do.	3 (9%)	9 (26%)	15 (43%)	8 (23%)	**2,80**
S (12.) I feel like our ICT capabilities are on par with our competitors.	2 (6%)	9 (26%)	17 (49%)	7 (20%)	**2,83**
M (9.) There is considerable…	2 (15%)	0 (0%)	7 (54%)	4 (31%)	**3,00**
M (10.) Our competitors are…	0 (0%)	3 (23%)	5 (38%)	5 (38%)	**3,15**
M (11.) Our competitors have…	1 (8%)	5 (38%)	6 (46%)	1 (8%)	**2,54**
M (12.) I feel like our ICT…	0 (0%)	3 (23%)	8 (62%)	2 (15%)	**2,92**
L (9.) There is considerable…	0 (0%)	7 (37%)	11 (58%)	1 (5%)	**2,68**
L (10.) Our competitors are…	1 (5%)	11 (58%)	3 (16%)	4 (21%)	**2,53**
L (11.) Our competitors have…	3 (16%)	10 (53%)	5 (26%)	1 (5%)	**2,21**
L (12.) I feel like our ICT…	2 (11%)	9 (47%)	7 (37%)	1 (5%)	**2,37**

Out of all of the areas covered with the survey, the final area produced what could be perceived as closest to what could be predicted results, as table 8 shows that, in general, ‘large’-sized organizations perceive their competitive position as being the incumbent with the largest amount of resources at their disposal. However, there were notable deviations that one could pick up on immediately.

Notably, 35% and 46% of ‘small’- and ‘medium’-sized organizations strongly or somewhat disagreed with the statement ‘our competitors have better resources for delivering Internet of Things solutions than we do’, indicating that there is either very little or no competition in this field or that these respondents’ organizations have made initiatives towards staying up-to-pace with development within the field. These two subgroups strongly or somewhat agreed with the statement of the field of delivering IoT solutions

as being highly competitive at rates of 86% and 85% respectively, indicating that these companies have at the very least, acknowledged the importance of the field.

Unsurprisingly, a notable portion of ‘large’- and ‘small’-sized companies strongly or somewhat disagreed with the statement ‘I feel like our ICT capabilities are on par with our competition’. However, this is most likely due to ‘large’-sized organizations perceiving their capabilities being comparatively competitive and ‘small’-sized organizations perceiving their capabilities being comparatively uncompetitive. However, it would require further research to verify this, as it may be as likely that the opposite is true.

The topic of perceived competitor size had interesting results, as ‘small’- and ‘medium’-sized organizations respondents predictably answered that their competitors are larger. However, a significant portion of 37% of the ‘large’-sized organizations concurred with this statement indicating that even some of the ‘large’-sized organizations experience competitive pressure due to firm size. However, this might be due to organizations’ employee counts being near the cut-off point of 25 employees, thus, making them some of the smallest ‘large’-sized organizations.

4.3 Respondent group analysis

The survey results indicate that the respondents could be divided into groups identified by company size and judging by the results, it seems like the before mentioned groups have similarities in the way they have responded to the survey. To test this hypothesis, each group’s results are compiled and examined further. To better understand the statistical significance of each group’s survey result mean averages, response standard deviations and variances are illustrated additionally.

Starting with the ‘small’-sized companies of the survey sample, tabled below in table 9, it can be identified that individual respondents of the group have responded to some survey questions with low deviations where others show more differentiating results.

Table 12 *'Small'-sized companies' results; mean averages, std. deviation and variance*

Q	N	Minimum	Maximum	Mean	Std. Deviation	Variance
1	35	2	4	3.3714	0.59832	0.358
2	35	1	4	2.9714	0.78537	0.617
3	35	3	4	3.4286	0.50210	0.252
4	35	2	4	3.2857	0.51856	0.269
5	35	2	4	3.2857	0.51856	0.269
6	35	2	4	3.1429	0.55002	0.303
7	35	1	4	2.5714	0.69814	0.487
8	35	2	4	3.0857	0.70174	0.492
9	35	1	4	3.0000	0.64169	0.412
10	35	2	4	3.4000	0.65079	0.424
11	35	1	4	2.8000	0.90098	0.812
12	35	1	4	2.8286	0.82197	0.676

The ‘small’-sized companies represented a significant portion of the survey results, accumulating to an N=35 of the survey’s N=67. All of the results tended to lean towards the upper end of the range from 1-4, with mean averages ranging from 2.57 up to 3.43, where questions 3, 4 and 5 resulted in the lowest variance of the sample. The questions resulting in the lowest variance were, by nature, the forward-looking questions of the question set, indicating that ‘small’-sized organizations approached change enthusiastically and agreed that this a point of focus within the organization.

The ‘medium’-sized companies of the survey sample, tabled below in table 10, were the smallest subset of the survey results, only accumulating to an N=13 of the survey’s N=67.

Table 13 *'Medium'-sized companies' results; mean averages, std. deviation and variance*

Q	N	Minimum	Maximum	Mean	Std. Deviation	Variance
1	13	3	4	3.7692	0.43853	0.192
2	13	2	4	2.9231	0.64051	0.410
3	13	3	4	3.6923	0.48038	0.231
4	13	2	4	3.3077	0.63043	0.397
5	13	3	4	3.3077	0.48038	0.231
6	13	3	4	3.6923	0.48038	0.231
7	13	1	4	2.6923	0.85485	0.731
8	13	2	4	3.0769	0.75955	0.577
9	13	1	4	3.0000	1.00000	1.000
10	13	2	4	3.1538	0.80064	0.641
11	13	1	4	2.5385	0.77625	0.603
12	13	2	4	2.9231	0.64051	0.410

Similar to the 'small'-sized companies' results, the mean averages of the 'medium'-sized companies' results had a wide range, ranging from 2.54 up to 3.77, however, some of the responses were significantly different from the 'small'-sized companies' results. Responses to questions 1, 6 and 11 greatly differed from the previous sample, with mean averages seeing a roughly +/- 10% change in the sample. Questions 1 and 6, measuring the importance of the focal technology moving forward, saw an increase of 0.3978 and 0.5494 respectively. The results of the 'medium'-sized company sample reflected the results of their 'small'-sized company counterpart in the organization's forward-looking questions, while emphasising the technology aspect further. However, the 'medium'-sized companies' sample was the smallest of the survey and some of the questions showed a significant variance in the results gathered.

Finally, the 'large'-sized companies of the survey sample, tabled below in table 11, accumulated to an N=19 of the survey's N=67.

***Table 14** 'Large'-sized companies' results; mean averages, std. deviation and variance*

Q	N	Minimum	Maximum	Mean	Std. Deviation	Variance
1	19	1	4	3.1579	0.95819	0.918
2	19	2	4	2.8947	0.73747	0.544
3	19	1	4	3.4737	0.96427	0.930
4	19	1	4	3.3158	0.82007	0.673
5	19	1	4	3.3158	0.94591	0.895
6	19	1	4	3.1579	0.83421	0.696
7	19	1	4	2.9474	0.84811	0.719
8	19	1	4	3.1579	0.95819	0.918
9	19	2	4	2.6842	0.58239	0.339
10	19	1	4	2.5263	0.90483	0.819
11	19	1	4	2.2105	0.78733	0.620
12	19	1	4	2.3684	0.76089	0.579

The final subset of the survey results, the 'large'-sized companies, significantly deviated from other results. Answers from the 'large'-sized companies showed the highest variance of all the respondents, indicating significant future perception differences within the subset. Surprisingly, however, the mean averages of the subset stayed relatively close to the previous two groups, only showing significant deviations within the later questions regarding perceived competition. Unsurprisingly, relative to the previous two subsets, the 'large'-sized companies did not perceive their competitors as being comparatively larger than them, resulting in a significant mean average decrease on question 10 of -0.8737 in comparison to 'small'-sized companies and -0.6275 in comparison to 'medium'-sized companies. The overall range of mean averages for the 'large'-companies' subset ranged from 2.21 to 3.47, with previously mentioned high variances of 0.721 on average.

4.4 Summarization of empirical results

Overall, the survey results seemed to indicate that the case company's business network had picked up on the importance of adopting Internet of Things as an important business decision to be considered moving forward. A significant majority of the firms within the network had identified the need for an increased service proposition, where

they could offer customers added customer value, in order to cope with increasing customer needs within the market. Surprisingly, there were no significant differences between the subgroups, indicating that the operating firms within the industry tend to close resemble incumbents rather than differentiating as disruptive innovators. However, some hesitancy in the adoption of IoT could be seen within the ‘large’-sized companies’ subgroup. However, even in this subgroup results indicating this were minor.

Almost all the respondents had recognized the need for developing ICT-capabilities and reported to address this need by continuously bettering their related capabilities. It should be noted though, that an online survey format lends itself to respondents answering the survey questions in a way that the respondents would expect one to answer them, rather than evaluating the statements truthfully. However, the responses kept internal consistency between them, e.g. resulting in IoT being seen as a heavily competed field resulting in the need for increased development of capabilities required.

Additionally, a significant portion of the survey respondents remarked that their organizations lacked the critical resources in comparison to what their competitors may have in providing IoT solutions to customers, while also agreeing on having the internal capabilities necessary to provide these solutions to customers. This may indicate the largest gap between the survey results as many of the respondents see their internal capabilities being at a required level, however, having limited resources to address customer needs in this area.

In regard to capabilities, the scope of the survey considered capabilities present in the previously mentioned organizations through what literature would describe as ordinary capabilities, and while the survey did not find significant differences in the perceived level of these capabilities, other forms of capabilities could pose significant differences between the organizations in the market.

Furthermore, the survey indicated that the target organizations for external development efforts should be in the ‘small’- and ‘large’-sized companies, as these are the two subgroups that, according to the survey seemed like the least adoptive towards Internet of Things solutions. Additionally, a significant enough portion of the ‘large’-sized organizations indicated that the products offered are lagging behind customer needs, indicating an area of improvement for product manufacturers.

5. DISCUSSION OF EMPIRICAL RESULTS

In this chapter the results are discussed in context of the theoretical background provided. Different results are evaluated within this context by providing a view on the current status and reflecting the results on what the possible target state would be. Based on the discussion, recommendations are made to enable possible development avenues in accordance to the empirical results gathered. In this chapter the validity of the empirical results is considered, and the feasibility of the recommendation is discussed.

5.1 Understanding capabilities

In accordance to the literature review presented in this study, the concept of capabilities has its roots within the resource-based view, a view that explains that at a foundational level companies can manage their competitive advantage by effectively and efficiently utilizing their resources. As Barney (1991) explained, resources the company has include all of its assets, including, among other things, knowledge, information and capabilities. At the time, a good portion of these (knowledge, information and capabilities) were tied to individuals working in the firm, in the form of tacit knowledge and what some would argue, ordinary capabilities. The rapid growth in information and communications technology created pressures towards codifying tacit knowledge into explicit knowledge and towards re-development of capabilities. With this rapid growth, the foundation what was believed to be behind competitive advantage had changed, where the source of competitive advantage would now be in either, dynamic capabilities (e.g. Teece, Pisano and Shuen, 1997) or in recombining existing capabilities with new technology (e.g. Helfat and Peteraf, 2003).

During the 1990's the rapid growth of IT posed a challenge to many established companies as the disruptive nature of the new technology had changed the rules of business. Similarly, the development known as the Internet of Things, Industry 4.0 or Industrial Internet is on its way to disrupt existing market dynamics and quite similarly, the approach to capabilities different firms are facing, resembles the 1990's. The source for competitive advantage derives from business activities, where dynamic capabilities are used to create new ordinary capabilities to answer the needs of the future, where existing capabilities are recombined with new capabilities enabled with the use of disruptive technology.

The Internet of Things, the aptly named third wave of the internet, consists of technological innovations that, with time, can prove themselves as or even more disruptive as the first wave was. And similar to the previous evolution of technology, dynamic capabilities and the recombination of capabilities raise in their importance. In accordance to Teece (1998), dynamic capabilities allow the firm to sense and seize new market opportunities with competences, technologies and complementary assets the firm has and as such, this provides an interesting lens from which to look at the empirical results gathered.

It should be mentioned that at the timeframe of the study, no industry standard on how the development of IoT should be done had been made, and as such the validity of statements made, can be rather difficult to evaluate. That said, from a point of view of a company residing in the case company's network, the results of the survey indicate that the companies are executing their strategies in accordance to the dynamic capabilities framework, as the companies are sensing a new market opportunity in the development of Internet of Things. However, there is room for arguing about the 'seize' part of dynamic capabilities as many of the 'small'- and 'medium'-sized organizations exhibit satisfactory results with the current product ranges, and as such, have yet to find ways on seizing the market opportunity presented to them. However, a portion of the 'large' companies have identified that the current product offering is lagging behind customer needs, and thus, from their perspective as well there is an opportunity to be seized.

From the perspective of the case company it is vital to be able to sense these market opportunities and have an offering capable of seizing the possible market opportunities presented. Ideal scenarios form a win-win-win situation where the case company, the companies within its network and the end customer benefit from a system where more comprehensive value is created to the end customer.

From a capability lifecycle perspective, in accordance to Helfat and Peteraf (2003), the development in the Internet of things follows the capability curve, where the current capabilities have reached their apex point and reached maturity. Moving forward, companies in the case company's network, in order to find competitive advantage, need to find a way to recombine their existing capabilities with possibilities provided from the utilization of new technology or if that is not possible, make the drastic decision to retire their existing capabilities in order to foster areas for new capability development within the new technology for seizing its opportunities. Due to resistance to change, this may

be difficult and companies not apt for making this change may see their competitive advantage eroded and see themselves exiting the market in the future.

Conversely, the recombination of existing capabilities can offer other possible avenues for new companies to join the network with an existing capability in IoT hardware or software development. One of the interviewees that was interviewed for the study went as far as to say that:

To capture a new industry […] it may even be easier to think that if I have a new product idea […] I'll build the software required and then find partners to make the hardware for it

In accordance to Gawer and Cusumano's (2014) 'network effects' approach, it may provide all the network incumbents added value if new companies with new sets of capabilities would enter the network. In terms of value creation this could prove to be a highly fruitful approach. However, in accordance to Chesbrough (2010), opening up the network in this way may be hinderance in value capture within the network.

From the case company's perspective the ideal approach to dynamic capabilities would be to exploit the firm-specific external competences, in accordance to Teece, Pisano and Shuen (1997). These capabilities present in the firm's network would allow for designing the firm's offering based on the competences present within the network. Another route could be taken through the implementation of training to kickstart the foundation of new capabilities and starting the process for the recombination of existing capabilities within the network. However, there are definite costs tied to this approach.

The survey questionnaire found that a significant majority of the firms within the case company's network perceived their capabilities as being at an adequate level for delivering Internet of things solutions to end customers, and thus, there are market opportunities for expanding the case company's portfolio with the capabilities already present, should the results reflect reality truthfully. To ensure the validity and applicability of the survey, a benchmark for the firms within the network should be set to make sure that the perceived adequate level translates to satisfactory results.

In accordance to the survey results, the companies within the network have concluded that there is demand for additional services around the basic install activity of an industry product and that a lot of these firms have claimed ambitions in developing additional

services. This offers an interesting avenue for co-development for the case company if the network's competence is required for service delivery. This may also be an enabler for the previously mentioned win-win-win scenarios. To capture this possibility, a possible pilot for a service could be co-developed with a set of companies within the network to verify the market demand and to create market pull for these types of offerings.

Present capabilities have their implications to possible business models that can be sought after. Existing capabilities can allow companies to seek out novel business models and conversely hinder the application of them should they not be adequate. The implications to business models are further discussed in detail in the next subchapter.

5.2 Adapting business models

As per the literature review of this study, the concept of a business model is abstract by nature and there is no academic consensus around what the business model concept entails and what the components of the business model should be. Adopting the concept of a business model, proposed by Osterwalder and Pigneur (2010) as a description of the rationale how the organization creates, delivers and captures value, a deeper look can be taken into how these steps are currently organized within the network as per the survey and discussions can be had around how different steps could be taken to adapt to disruptive technological innovations, e.g. the development in the Internet of things.

The concept of value plays a key role in business model research across different studies conducted by different authors and, thus, provides an approach point to opening the discussion on how business models should be adapted moving forward. According to the literature review, the Internet of things poses different challenges in value creation, value delivery and value capture. These approaches to value can be vastly different depending on the goals of the organization. Ultimately, at the end of the day, the concept of value is determined by customers by their willingness to pay for a product, service or a solution combining the two.

As the adoption of the Internet of things continues, increasingly novel value offerings are enabled through the use of data and analytics, where companies are able to offer customers extended value through actions based on the data collected. Depending on the firm's motivations in adopting Internet of things-enabled activities into its portfolio, explained in detail in the previous chapter about the context of the empirical research,

firms may seek to adopt different approaches towards the introduction of IoT and the effects in their business models through this adoption can highly vary.

If the main driver of the firm is to appear innovative in the eyes of its customers, the impacts on the business model should remain rather small and the initiatives should reflect this by being small scale. However, this approach may lead to the firm being vulnerable for disruption in the market and render the firm unable to answer to firms adopting a more “customer value first oriented” approach. In accordance to the literature review, incorporating Internet of things solutions to the company’s existing product mix may help the firm escape commoditization of its current products, thus, an approach towards IoT may be strategically defensive from the point of view of competitive threats and customer-facing threats.

Internet of things may allow manufacturing firms to boost their servitization efforts in order to find increased profits in the market (e.g. Rymaszewska, Helo and Gunasekaran, 2017). The empirical part of this study found that the industry is undergoing a shift into a direction that is more service-focused, and as such, servitization efforts may be warranted in business model design moving forward. However, if capabilities in managing and operating data are lacking, these efforts will find lacklustre performance results. The empirical results indicate that the organizations within the case company’s network are open to expanding their service portfolio and even have started initiatives towards that direction, which would indicate that there are possibilities in incorporating elements of servitization in the business model of the case company.

From a value creation perspective, in accordance to Chesbrough (2010), the case company may pursue strategies extending the customer value of its product mix by adopting Internet of things-enabled solutions to its product line and open these initiatives to the network to further entice the value creation aspect in a network approach. Through ‘network effects’, explained in the literature review, this may also invite companies to join the business network and start the development of value adding features to consumers. However, according to Chesbrough (2010), this may make it more difficult for value capture to occur within the network, making it more difficult to pursue financial benefits presented in the adoption of Internet of things.

In accordance to Teece (2010) and Chesbrough (2010), in order for value capture efforts to be viable the case company would approach the development through inclusion of protecting its knowledge assets and through development of new products without

taking advantage of the network effects present in open innovation initiatives. This, however, would most likely require vertical integration to mitigate contractual hazards. However, Adner and Kapoor (2010) argued that the approach to strategy that incorporates vertical integration is more suitable for situations of technological maturity, instead of technological emergence.

The empirical results suggest that the case company's network's perceptions of the market are that Internet of things applications should have increased customer value and thus, it seems like there is room for incorporating disruptive technologies in the product mix. However, as the previous subchapter suggests, there needs to be efforts in verifying the capabilities within the network to ensure that there are no surprises in rolling out new and novel business models in the industry. As Valtakoski (2017) found in his research, one of the key issues in servitization failure arises from the lack of capabilities in knowledge transfer and codification. A consideration should also be put into place if the customers themselves have better capabilities in their knowledge management, and if this would be the case, there may be potential challenges rising from the fact.

Furthermore, if the customer base has better knowledge about the components of the system and have better integrative capabilities, there may even be possible pressures arising due to deservitization pressure. As such, there is room for further research on the market conditions when it comes to customers as it may be that customers may already have initiatives in these fields. Thus, rendering the case company's efforts in value addition valueless to the customers.

As this study approaches the business models through the canvas model known as the lean canvas, a deeper look should be taken into the components that constitute the lean canvas. As the literature review explained earlier in this study, the lean canvas consists of nine building blocks: **customer segments**, **problem**, **unique value proposition**, **solution**, **channels**, **revenue streams**, **cost structure**, **key metrics** and **unfair advantage**. So far, the discussion has considered the value proposition, the channel and the revenue streams, however, to have a more comprehensive view on the business model, that should be applied, further consideration should be put into the other areas of the lean canvas as well.

During the interview phase of the study, certain topics related to the lean canvas repeated several times. By far the most commonly raised topic in regards to business

model change in adopting Internet of things solutions was in the **unique value proposition**, and, as such many of the interviewees explained the changes in value proposition followingly:

Right now, we configure our machines to fit the customer needs […] IoT could take this a little bit further […] enabling us to promise the customers added value

Data moving up and down the value stream allows everyone to win […] data allows each participant to add value at every step of the value chain

These optimistic views, however, were accompanied by reservations if the customer facing business network participants would be able to capture these opportunities within the market as some of the interviewees commented the topic by stating:

IoT gives the customer facing companies that we deal with new opportunities, especially in expanding their business […] problem is how are we connected to the picture and what is the deal between us and the customer facing businesses […] The complete offering has to also be something that benefits the customer, in value that they are ready to pay for

If we use the data collected to sell customers added value through uptime selling […] we need to have our dealers connected to this promise […] dealers are, at the end of the day, the ones that run the operation day-to-day

These comments reflected on the literature review, as Leminen et al. (2018) explained that the value propositions within these types of business networks are no longer static, but are dynamic. The network participants constantly add value to the proverbial offering, and thus, every participant in the network has to be considered for the creation of value to occur within these types of products. The topic of **channels** did not get explicitly mentioned in any of the interviews, however, a lot of the discussion centred around the idea of how the added value would be delivered to the end customer and what would be the path to reaching those customers. Thus, making **channels** as discussed of a topic as the **value proposition**.

Revenue streams were also discussed in detail repeatedly in the interviews, often returning to novel pricing structures for the value offered to customers. Some of these went as far as proposing outcome-based pricing structures, where the customer would

only play for the increased performance, they would receive from using the product. However, these thoughts often led to the conclusions where it would be too difficult for the focal firms to gather all the data and keep it up to date and account for the challenges that arise from heterogeneity of the products' use environments, as one interviewee explained:

It is completely different if you put a machine inside a manufacturing hall in homogenous conditions than to take a machine like this to face the rain, the coal dust, the freezing rain and work under those conditions […] the demands for these types of environments are completely different

Following the three most popular topics; the **solution**, the **unfair advantage** and the **customer segments** were discussed in a lesser extent during the interview phase, with discussion often revolving around how a firm could find **unfair advantage** by incorporating new innovative technological components to their value offering and discussion on understanding who the **early adopters** would be within the target customer segments that are pursued by the firm. Furthermore, all of these topics aimed to reflect on the **problem** the customer may or may not have that the **solution** is bound to fix. One interviewee explained this as:

In IoT, like in anything new […] I don't believe there is a technology risk, the technology is there […] the risk lies in the question, is there a market for this […] products are often designed in a way that they don't solve the problem the customer has and then no one is willing to pay for it

The empirical results have major implications in regards to business model development, as the technology continues to develop, the firm is faced with strategical choices in the balancing act that occurs between value creation and value capture. This will inevitably lead into an emphasis onto one of these often foregoing the other. To elaborate on the concept of value in a business network, a further discussion of this can be found in the next subchapter.

5.3 Restructuring business networks

The development within Internet of things interconnects products and services to form larger systems and changes the nature of value offered to end customers. In accordance to the literature review, the concept of value is often no longer persistent, where value is

assigned to the performance of a task, but conversely, is often now dynamic, where value is added to the product or service during its lifecycle by the business network around the product.

From a purely value creation perspective, the creation of open platforms is the most attractive way to approach emerging technology, as this will allow network outsiders to join the network and add value to the network through 'network effects', thus, allowing significant value creation all across the network. In an open platform, the approach to data should also follow the openness of the platform where data should be shared among participants readily to allow each participant to optimize their efforts in value creation. However, in practice, the approach to data and knowledge can vary greatly depending on the situation at hand, as interviewees explained:

It is highly likely that soon in the future, customers will start to discuss data ownership […] the machine the customer uses collects data, however, the customer is not willing to let the data collected leave their premises

The difficulties arise from the fact that everyone assumes there is large amounts profits to be made from IoT […] every participant wants a cut from the data generated […] these systems are not built if everyone is fighting about contracts

In practice, network participants can approach new technology innovations opportunistically and expect value to be captured rather than being created. This is reflects the findings of the empirical research and the literature review that found that many companies often approach IoT from a financial perspective, searching for increased profitability and increased revenues.

All of this in mind, the approach to business networks should be, during technological emergence, one where the focal firm searches for network partners that approach the technology from a value creation perspective rather than from a value capture perspective. As value is created through the development of the technology and the technology's adoption rate increases, companies may shift their approach from a value creation oriented one to a value capture one, where the grown platform could eventually be leveraged.

The scope of value creation should not only be restricted to only include platform participants but should also allow for customers to add value during development

phases. This emphasizes the need for finding suitable **customer segments** with the **early adopters** that would be committed to the value creation efforts taken by the focal firm and would be committed to partake in the value creation efforts themselves.

For the business network to be successful, the capability set of the participants should be complementary to each other, where the competencies offered to the network are not identical between the participants but similar in the way that the competencies can be utilized by all the participating members of the network. If approached correctly, these networks would allow participants to focus their efforts on their core competences and would allow the participants to benefit from external capabilities where they would be needed. It is also characteristic for these networks to expand to sizes where it is impossible for a single firm to solely be in charge of the value creation within the network due to limited resources and significant scale.

The survey questionnaire found that, even the perception of current capabilities to deliver IoT solutions was somewhat lacking. Thus, the case company's network has possibilities for firms with capability sets that are currently not offered within the network. Companies that are solely focused on the Internet of things solutions side of business could offer the network greater value creation potential overall, allowing every participant of the network to 'win'. However, the additional efforts in the network should be made sure to add value to the customers in a way where customers are willing to pay for the added value.

5.4 Reliability, validity and limitations of the study

The structure of this study has inherent limitations to its reliability and validity. The study employs both qualitative and quantitative research, and thus validity and reliability have to be approached from two different perspectives. In qualitative research, consideration for validity can be described as a concern for accuracy and truthfulness of scientific findings (Le Comple and Goetz 1982, in Brink, 1993). Brink (1993) adds that this type of validity can refer to "internal" and/or "external" validity, where internal validity is a term used to refer to the degree to which the research findings are a true reflection of reality rather than being affected by irrelevant variables. Conversely, external validity addresses the degree to which the research findings are a reflection of reality that can be applicable across groups. Following Joppe (2000) validity could be attributed to three key metrics; accurateness, consistency over time and representativeness regarding the

total population. In qualitative research, it can be argued that reliability is a consequence of validity, thus making it so that testing for validity can establish reliability.

First, the accurateness of the qualitative part of the study was approached by including a variety of sources, methods and by employing a group of evaluators of the study, acting as a basis for study iteration. This study was supported by multiple strands of literature, including journal articles, books and practical conference papers. The study employed a multimethod research method where interviews and a literature review were conducted. The study aimed to approach the subject from different distinct perspectives to ensure accuracy.

Consistency over time, repeatability, may pose as one of the most significant issues of the study. The study was conducted in the context of a case company, at a very specific point of technology development, while the technology was still in its emergence. Furthermore, the study took place during the end of 2018 and the beginning of 2019 where the applicability of the technology is still seeing its struggles. Especially building viable business cases around said technology may prove itself significantly easier after a couple of years of waiting. Thus, resulting in similar studies arriving at different results in a later date.

Another significant issue for this study lies in its representativeness of the total population. The study was conducted in the context of a case company, thus leading to the likelihood that the case examples selected could be seen as extreme, non-representative examples of a broader population. To establish a more representative study, case examples could have been drawn across industries. However, expanding the study to incorporate samples from outside the case company would have most likely been hindered due to limited access and limited time. Certain dynamics of the case company's market may not be present in other industries and the position the case company enjoys is rather unique in a broader sense. This also may lead to representativeness issues, as there may not be many companies that have a similar position in their value chain. However, the structure of the study may have been broad enough to result in similar results in other cases as well.

As established the validity and reliability of the qualitative part of the study may be challenged, due to the issues brought up above. However, the discussion of validity and reliability can also be extended to the quantitative parts of the study. This part of the study, more specifically the survey, can be tested for internal reliability and correlations.

The survey was first tested for statistical relationships between variables. This was done by calculating Pearson’s correlations for the survey sample, tabled below in table 12.

***Table 15** Pearson's correlations; relationships between variables*

		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
Q1	Pearson Correlation	1	0.217	.551**	.446**	.494**	.462**	.292*	.359**	0.158	0.209	0.118	0.143
	Sig. (2-tailed)		0.078	0.000	0.000	0.000	0.000	0.016	0.003	0.201	0.089	0.342	0.248
	N	67	67	67	67	67	67	67	67	67	67	67	67
Q2	Pearson Correlation	0.217	1	.373**	.531**	.259*	0.219	0.127	0.169	0.163	-0.014	-0.204	.334**
	Sig. (2-tailed)	0.078		0.002	0.000	0.034	0.075	0.306	0.171	0.187	0.908	0.097	0.006
	N	67	67	67	67	67	67	67	67	67	67	67	67
Q3	Pearson Correlation	.551**	.373**	1	.773**	.534**	.579**	.261*	.457**	0.224	0.070	0.047	0.126
	Sig. (2-tailed)	0.000	0.002		0.000	0.000	0.000	0.033	0.000	0.068	0.574	0.705	0.310
	N	67	67	67	67	67	67	67	67	67	67	67	67
Q4	Pearson Correlation	.446**	.531**	.773**	1	.445**	.436**	.278*	.368**	0.196	0.141	0.010	0.142
	Sig. (2-tailed)	0.000	0.000	0.000		0.000	0.000	0.023	0.002	0.112	0.253	0.937	0.252
	N	67	67	67	67	67	67	67	67	67	67	67	67
Q5	Pearson Correlation	.494**	.259*	.534**	.445**	1	.491**	.387**	.563**	.254*	0.025	0.036	0.020
	Sig. (2-tailed)	0.000	0.034	0.000	0.000		0.000	0.001	0.000	0.038	0.839	0.771	0.874
	N	67	67	67	67	67	67	67	67	67	67	67	67
Q6	Pearson Correlation	.462**	0.219	.579**	.436**	.491**	1	.327**	.360**	.307*	0.006	-0.208	0.111
	Sig. (2-tailed)	0.000	0.075	0.000	0.000	0.000		0.007	0.003	0.011	0.961	0.091	0.373
	N	67	67	67	67	67	67	67	67	67	67	67	67
Q7	Pearson Correlation	.292*	0.127	.261*	.278*	.387**	.327**	1	.301*	0.088	-0.091	-0.142	-0.163
	Sig. (2-tailed)	0.016	0.306	0.033	0.023	0.001	0.007		0.013	0.480	0.465	0.253	0.186
	N	67	67	67	67	67	67	67	67	67	67	67	67
Q8	Pearson Correlation	.359**	0.169	.457**	.368**	.563**	.360**	.301*	1	.262*	0.029	0.087	0.048
	Sig. (2-tailed)	0.003	0.171	0.000	0.002	0.000	0.003	0.013		0.032	0.813	0.483	0.697
	N	67	67	67	67	67	67	67	67	67	67	67	67
Q9	Pearson Correlation	0.158	0.163	0.224	0.196	.254*	.307*	0.088	.262*	1	0.194	0.158	0.035
	Sig. (2-tailed)	0.201	0.187	0.068	0.112	0.038	0.011	0.480	0.032		0.116	0.201	0.780
	N	67	67	67	67	67	67	67	67	67	67	67	67
Q10	Pearson Correlation	0.209	-0.014	0.070	0.141	0.025	0.006	-0.091	0.029	0.194	1	.620**	0.068
	Sig. (2-tailed)	0.089	0.908	0.574	0.253	0.839	0.961	0.465	0.813	0.116		0.000	0.584
	N	67	67	67	67	67	67	67	67	67	67	67	67
Q11	Pearson Correlation	0.118	-0.204	0.047	0.010	0.036	-0.208	-0.142	0.087	0.158	.620**	1	-0.021
	Sig. (2-tailed)	0.342	0.097	0.705	0.937	0.771	0.091	0.253	0.483	0.201	0.000		0.869
	N	67	67	67	67	67	67	67	67	67	67	67	67
Q12	Pearson Correlation	0.143	.334**	0.126	0.142	0.020	0.111	-0.163	0.048	0.035	0.068	-0.021	1
	Sig. (2-tailed)	0.248	0.006	0.310	0.252	0.874	0.373	0.186	0.697	0.780	0.584	0.869	
	N	67	67	67	67	67	67	67	67	67	67	67	67

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Noticeably, the survey's first eight questions seem to show statistical internal correlations between each other, while the survey's last four question seem internally correlative. The survey was distributed into three categories, each consisting of four questions, thus making the latter (the last four questions to have internal correlation) expected. However, it also seems like the first two categories of the survey were correlative with each other, resulting in respondents reflecting the market readiness with their internal competence, or vice versa. This might put into question how accurate the perceptions of the respondents are, as there may have been a skew towards answering that the market is ready for new innovative products if the respondent's organization possesses the required competence for delivery or the other way around.

The survey was also tested for reliability using Cronbach's alpha calculations. Following a rule of thumb presented by Mallery and George (2003); " > .9 – Excellent, >.8 – Good, >.7 – Acceptable, >.6 – Questionable, >.5 Poor, and <.5 – Unacceptable", a benchmark for reliability for the study could be established.

The survey results, tested for reliability, scored a Cronbach's Alpha of 0.752, falling under the "Acceptable"-range of the rule of thumb established above. Thus, the survey shows statistical reliability for the sample. According to Mallery and George (2003), the internal statistical reliability of a sample set increases when the number of items is lowered, thus, if the survey was condensed to two categories of four questions, the internal reliability could have been higher. However, this would have come with a trade off in topics covered by the survey, offering the researcher a narrower view of the situation at hand.

Overall, the study's quantitative reliability and validity show acceptable results, and, thus, the survey's results can be seen as representative of the study sample. Per the prior discussion, the study's qualitative reliability and validity can be questioned as the study's results are most likely representative of the time when the study was conducted and are highly constrained to reflect the situation within the case company. Thus, generalization of the study results is highly limited.

5.5 Recommendations

The study identified and explained the link between the business model and the existing capabilities and contextualized these concepts in the context of the innovation eco-

system. The survey questionnaire identified the current set of capabilities that are currently present in the network and identified what kind of possibilities these capabilities would allow the case company.

To contextualize the results gathered in the survey questionnaire, a look back into, what the hypotheticals were in building the survey questionnaire, is warranted. The survey questionnaire was built upon the assumptions that:

- The firms within the case company's network would consider their expertise in Internet of Things solution delivery to be limited
- The perceived potential in business model expansion would be fragmented within the network
- Some customers are expecting more comprehensive solutions, and
- Differentiating competence factors could affect the nature of competition within the network.

Now with the results collected, recommendations can be drafted around these assumptions to reflect on how the underlying assumptions reflected on the current situation and how they deviated from the gathered results. Additionally, suggestions are made, based on how the results reflected the assumptions that were and on what the indications of the results may be moving forward. Each of the bullet points above is considered in the following sections with the second and third bullet point combined to a single section as the two areas are reflective of one another.

5.5.1 Perceived expertise

The first underlying assumption about the network was that the companies occupying the network would consider their competence set to be fairly limited when it came to the delivery IoT solutions. Some of the respondents in the survey concurred with this statement and believed that internally their organizations would be ill-equipped to handle the delivery of IoT solutions. However, this view was only shared by 26% of the 'small'-sized organizations, by 23% of the 'medium'-sized organizations and by 32% of the 'large'-sized organizations. Conversely, this would indicate that roughly 70% of the respondents consider their capability set as adequate for delivering technologically challenging IoT products.

Given these results, the case company could approach launching possible new IoT-enabled solutions through a few similar scenarios and strategies;

- The case company could identify the roughly 30% of network participants and develop their capabilities so that they would ready for the possible launches.
- The case company could approach the situation by accepting the current limitations of the business network and ready themselves to be more hands-on in roughly 30% of cases where capabilities do not meet the requirements needed for delivery.
- The case company could build a benchmark to what level capabilities would be required and build a new business network around delivering these specific products that pass that benchmark.

The survey questionnaire did not consider how the companies within the business network were geographically located, and as such, there is no guarantees that the firms that perceived their capabilities as adequate can provide a nationwide coverage for the case company and if this is duly important, the case company may be forced to take the first option of identifying the current gaps and developing their capabilities to a required level.

However, if this is not necessary, the other two options may pose themselves as less resource-intensive and allow the case company to better exploit the external capabilities present within the network. However, it should be noted that to be sure of the level of capabilities in the network the research should be repeated in a way where technical details are considered in more specific detail, as it may be easy for the respondents to overestimate their current skillset.

5.5.2 Potential for business expansion

The second assumption that was made in building the survey questionnaire was the fact that there would be huge differences in the potential areas where the business model of the case company could be expanded to with the current network and the third assumption assumed that there would be a portion of the customer base that is expecting more comprehensive solutions to be offered. The hypotheticals, thus, presumed that there would be significant deviations between the survey responses, in that some would

answer that there are no needs for additional services, and that some respondents have not thought of expanding their business to cover these additional service needs.

The survey found that an overwhelming majority of respondents had ambitions in expanding their service portfolio in the following five years and that there were significant customer needs for these types of additional services. These results indicate that the firms within the network are currently seeking ways to expand their service offering, and as such, there may be significant opportunities for the case company to take part in this expansion of business. The results are significant enough to indicate that the companies within the network are most likely undergoing efforts in expanding their service offering with or without the case company. This may pose possibilities in the fact that there may be opportunities in co-development of services.

This co-development should be organized in a way where every participant is a beneficiary from the arrangement and in a way that creates additional value to the end customer. It is thus, vital to understand what kind of capability sets each of the network partners possess and it is important to leverage those capabilities. This may also include the development of minimum viable products (MVPs) with customers to make sure that the end products are developed in a way that brings customers added value. This may help the case company keep their costs down as well as allow for development in a way where investment burdens are shared within the network. Like with any emerging technology, this would require more open approaches to data and innovation, possibly hindering value capture possibilities within the network.

5.5.3 Inner network competitive situation

The final assumption made, in developing the survey, was that the different capability sets present in different firms within the case company's network would affect the nature of competition between the firms. The survey design did not directly answer this topic and further research would be required to understand the complexity of competitiveness within the network. However, the survey did illustrate that especially in the 'small'- and 'medium'-sized businesses firm respondents did portray their resources to be comparatively lacking when compared to their competitors. However, these respondents also concurred that their firms are actively working on bettering their capability sets to remain competitive and in order to face future challenges, indicating that there are initiatives in place to answer issues caused by the lack of resources.

An approach that could be taken to address the situation, could be to nurture these development initiatives by offering training, and thus, enabling companies to reach a level where their resources could be perceived as comparable within the network. Without further research, it could be difficult to determine if ‘small’- and ‘medium’-sized organizations are developing their capabilities to offer the customers a more comprehensive set of solutions, contrasting to how much of this development is only due to ensuring firm survival under perceived technological disruption.

6. CONCLUSIONS

This chapter contains the key findings of the study. First, the chapter lists its practical findings by comparing the study findings to the original research questions and considers how well the study managed to answer these questions. Second, the chapter discusses the possible scientific contributions of the study and finally, the chapter describes the potential avenues for future research and lists possible limitations for the study.

6.1 Research conclusion

This study explained its objectives through three research questions illustrated in the introduction chapter of the study, that were:

RQ1: How can companies develop business models suitable for change caused by the advent of Internet of Things?

RQ2: What elements of the business model raise in significance when bringing Internet of Things solutions to the market?

RQ3: How can companies identify external capabilities that affect business model development through a fundamental change, such as the advent of Internet of Things?

The concept of a business model was thoroughly explored in the study, explaining the roots and the definition for the concept. The literature review found that the business model concept, though researched, has yet to have a consensus around its components and its contents. The current interest in business models research rose from the first wave of internet when firms found themselves with vastly more possibilities in business than were previously available. Similar to the first wave of the internet, the Internet of things seems to have similar results where companies have even more possibilities. However, the study found that there are specific changes that occur midst the development of IoT. The definition of a business model adopted in this study was *a description of the rationale of how an organization creates, delivers and captures value* (Osterwalder and Pigneur, 2010).

The study found that the Internet of things changes the perception of value, how its created, how its delivered and how its captured. As prior to modern platform-based economies that are powered by IoT solutions, value was often persistent over time whereas within the context of Internet of things it becomes dynamic, adding over time. The interconnected nature of these products and services offered through these platforms often creates interdependencies between ecosystem participants where companies are reliant on external competences and capabilities to succeed.

To boost the technological emergence, that include development into different types of variations of Internet of things solutions (e.g. machine learning, AI, advanced analytics etc.), platform participants may need to focus on open data transfer and open innovation, by focusing their efforts solely in value creation. This often comes at a cost, with limited possibilities in value capture, and as such, these platforms often require partnerships where participants are less opportunistic.

The study adopted the lean canvas model as a structural tool to evaluate and to conceptualize the business model. Through this model, considerations were made in what areas of the business model would raise in importance through the development of IoT. The study found that the two most important areas for business model development moving forward would be in the unique value proposition of the company, in the channel the value is delivered in and in the revenue streams that are made possible with the use of IoT. The study approached the phenomenon, that is known as the IoT, through a generic approach, and thus, the study was more focused on the concept of business models going through a period of technological disruption on a general level, more so than how IoT creates disruptions specifically.

The study discussed how the firm’s external capabilities can affect business model development and considered possible avenues for establishing a healthy platform for firms to operate in. The study also discussed the implications of lacking external capabilities in an interconnected world and the implications of adequate complementary external capabilities within a network structure. External capabilities, in this case, were found to have significant business strategy implications and some of the possible approaches were listed in the study.

Based on these conclusions, the research, on a very general level, answered its research questions. However, there are several avenues in how the research could be

focused to be more specific. Possibilities for future research are explained in more detail in its own subchapter.

6.2 Scientific contribution

This study explored the current research in the fields of capabilities, in business models and in innovation ecosystems, and as such, the study aimed to bring more clarity in what ways these topics are interrelated and how murky these topics can appear. The study found that there are still significant steps to be taken in creating a unified concept that would allow for better practical use of the previously listed terms.

The study's goals were to create material for practical use and as such the scientific contributions of the study were fairly limited. The study, however, connected previously mentioned topics together and aimed to find linkages between the business model, the innovation ecosystem and the existing capabilities. The study aimed to shed light on a specific case of Internet of things adoption and explain how, on a general level, the Internet of things is going to change the landscape of business.

6.3 Avenues for future research

This study found several different avenues for future research, of which some were already discussed prior in the study. First, the study design chosen approaches the phenomenon of Internet of things, that contains many different disruptive technologies, on a fairly general level, providing results that may leave the discussion to be fairly unspecific. A further study could be made in to a specific application of the Internet of things, e.g. advances analytics and what the avenues are within that topic for business model innovation. There may also be room for future research grounding the topic in more practical terms when there are cost and revenue projections available for creating a reference point to. Additionally, there are interesting areas for future research as the adoption rate for the Internet of things increases, as of the moment of the research, the term has been used as a buzzword with no contextual bearing.

Additionally, a significant avenue for future research in this specific case context, could be in studying the potential customer wants and needs within the market. Currently, there are many assumptions on what the added value components of Internet of things solutions could be, and as value can be defined by the customer's willingness to pay for

something, fruitful research could be found within defining how valuable these applications truly are. Especially interesting would be to differentiate applications by their marginal cost and cross-reference those results to how valuable each benefit would be to the end customer. Within the context of the Internet of things, there are several service and solution opportunities that pose a marginal cost of zero, that could still be valuable to the customer.

Furthermore, an interesting topic for future research could be in measuring the cost effectiveness of training within the highly specific case context. This study makes vague assumptions about the cost implications of developing external capabilities. However, it could be fruitful to study the context for future research to understand the cost to payoff ratio in these types of endeavours. Further in the future, there may also be possibilities for future studies in studying the cost and revenue effects between external capability development and vertical integration as both could be seen as an answer of sorts to an issue in approaching networks.

Finally, recreating the study with the modifications discussed above in a different industry could also provide fruitful results and could offer interesting avenues for discussions on the dependencies of capabilities in different industries. Internet of things enabled business models are often similar with each other (value is often derived from similar things). However, there are industry- and firm-specific things that come into the fray affecting the results, and as such, a study into another industry should be considered.

REFERENCES

Adner, R. (2006) ‘Match Your Innovation Strategy to Your Innovation Ecosystem.’, *Harvard Business Review*. Harvard Business School Publication Corp., 84(4), pp. 98–107. Available at: http://search.ebscohost.com/login.aspx?direct=true&AuthType=cookie,ip,uid&db=bsu&AN=19998909&site=ehost-live&scope=site&authtype=sso&custid=s4778523.

Adner, R. and Kapoor, R. (2010) ‘Value Creation in Innovation Ecosystems: How the Structure of Technological Interdependence Affects Firm Performance in New Technology Generations’, 333(October 2009), pp. 306–333. doi: 10.1002/smj.

Afuah, A. (2004) *Business models: A strategic management approach*. McGraw-Hill/Irwin.

Al-Debei, M. M. and Avison, D. (2010) ‘Developing a unified framework of the business model concept’, (January), pp. 359–376. doi: 10.1057/ejis.2010.21.

Allmendinger, G. and Lombreglia, R. (2005) ‘Four strategies for the age of smart services’, *Harvard Business Review*, 83(10).

Amit, R. H. and Zott, C. (2013) ‘The Business Model : A Theoretically Anchored Robust Construct for Strategic Analysis The Business Model : A Theoretically Anchored Robust Construct for’, 11, pp. 403–411.

Amit, R. and Zott, C. (2001) ‘VALUE CREATION IN E-BUSINESS’, 520(February 2000), pp. 493–520. doi: 10.1002/smj.187.

Amit, R. and Zott, C. (2012) ‘Creating Value Through Business Model Innovation’, *MIT Sloan Management Review*, Special Co, pp. 36–44. doi: 10.1002/pen.24648.

Anand, B. and Khanna, T. (2000) ‘Do Firms Learn to Create Value? The Case of Alliances’, *Strategic Management Journal*, 21(3), pp. 295–315.

Applegate, L. M. (2000) ‘E-Business Models: Making Sense of the Internet Business Landscape’, in *In Information Technology and the New Enterprise: Future Models for Managers*.

Au, Y. A. (2001) ‘Design Science I : The Role of Design Science In Electronic Commerce’, pp. 1–15.

Barney, J. (1991) ‘Firm Resources and Sustained Competitive Advantage’, *Journal of Management*, 17(1), pp. 99–120. doi: 10.1177/014920639101700108.

Bartlett, C. A. and Ghoshal, S. (1987) ‘Managing Across Borders : The Transnational Solution Managing across Borders : New Organizational Responses Christopher A Bartlett ; Sumantra Ghosbal’, *Sloan Management Review*, 43(Fall 1987). doi:

10.2307/258620.

Betz, F. (2002) ‘Strategic business models’, *Engineering Management Journal*, (March).

Bhatt, G. D. and Grover, V. (2005) ‘Types of Information Technology Capabilities and Their Role in Competitive Advantage : An Empirical Study’, 22(2), pp. 253–277.

Borch, O. J. and Madsen, E. L. (2007) ‘Dynamic capabilities facilitating innovative strategies in SMEs Dynamic capabilities facilitating innovative strategies in SMEs Odd Jarl Borch * and Einar Lier Madsen’, (March 2014). doi: 10.1504/IJTE.2007.014731.

Boulton, R. E., Libert, Ba. D. and Samek, S. M. (2000) ‘A business model for the new economy’.

Brink, H. I. L. (1993) ‘Validity and Reliability in Qualitative Research’, in *Curationis*, pp. 35–38.

Chesbrough, H. (2007) ‘Business model innovation : it ’ s not just about technology anymore’, *Strategy & Leadership*, 35(6). doi: 10.1108/10878570710833714.

Chesbrough, H. (2010) ‘Business model innovation: Opportunities and barriers’, *Long Range Planning*. Elsevier Ltd, 43(2–3), pp. 354–363. doi: 10.1016/j.lrp.2009.07.010.

Chesbrough, H., Lettl, C. and Ritter, T. (2018) ‘Value Creation and Value Capture in Open Innovation’, 35(6), pp. 930–938. doi: 10.1111/jpim.12471.

Choi, J. *et al.* (2012) ‘Understanding the Language, the Culture, and the Experience : Translation in Cross-Cultural Research’, *International Journaly of Qualitative Methods*, pp. 652–666.

Christensen, C. M., Verlinden, M. and Westerman, G. (2002) ‘Disruption, disintegration and the dissipation of differentiability’, *Industrial and Corporate Change*, 11(5), pp. 955–993. doi: 10.1093/icc/11.5.955.

Dedehayir, O., Mäkinen, S. J. and Ortt, R. J. (2016) ‘Roles during innovation ecosystem genesis: A literature review’, *Technological Forecasting and Social Change*. Elsevier Inc., 136, pp. 18–29. doi: 10.1016/j.techfore.2016.11.028.

Demil, B. and Lecocq, X. (2010) ‘Business Model Evolution : In Search of Dynamic Consistency’, 43, pp. 227–246. doi: 10.1016/j.lrp.2010.02.004.

Dijkman, R. M. *et al.* (2015) ‘Business models for the Internet of Things’, *International Journal of Information Management*. Elsevier Ltd, 35(6), pp. 672–678. doi: 10.1016/j.ijinfomgt.2015.07.008.

Eisenhardt, K. M. and Martin, J. A. (2000) ‘DYNAMIC CAPABILITIES : WHAT ARE THEY ?’, 1121, pp. 1105–1121.

Finne, M. and Holmström, J. (2013) ‘A manufacturer moving upstream: Triadic collaboration for service delivery’, *Supply Chain Management*, 18(1), pp. 21–33. doi: 10.1108/13598541311293159.

Fleisch, E., Weinberger, M. and Wortmann, F. (2014) ‘Business Models and the Internet of Things (White Paper)’, *Bosch IoT Lab*, (SEPTEMBER), p. 19. doi: 10.13140/RG.2.1.3824.2008.

Gambatese, J. A. and Hallowell, M. (2011) ‘Enabling and measuring innovation in the construction industry’, (June), pp. 553–567. doi: 10.1080/01446193.2011.570357.

Gawer, A. and Cusumano, M. A. (2014) ‘Industry Platforms and Ecosystem Innovation’, 31(3), pp. 417–433. doi: 10.1111/jpim.12105.

Glick, J. L. (2008) ‘Biotechnology business models work : Evidence from the pharmaceutical marketplace’, 14(2), pp. 106–117. doi: 10.1057/palgrave.jcb.3050085.

Gordijn, J. and Akkermans, H. (2001) ‘Designing and Evaluating E-Business Models’, *IEEE Intelligent Systems*. IEEE, 16(August), pp. 11–17. doi: 10.1109/5254.941353.

Grant, R. M. (1996) ‘Prospering in Dynamically-competitive Environments’:, *Organization Science*, 7(4), pp. 375–387.

Gummesson, E. (1993) *Case study research in management: Methods for generating qualitative data*. Stockholm University, Department of Business Administration.

Hakanen, T. *et al.* (2016) ‘Boosting service export - a roadmap for IoT enabled business models Boosting service export : a roadmap for IoT-enabled business models Taru Hakanen * Matti Muikku’, (December 2015).

Hedman, J. and Kalling, T. (2003) ‘The business model concept : theoretical underpinnings and empirical illustrations’, (December 2001), pp. 49–59. doi: 10.1057/palgrave.ejis.3000446.

Helfat, C. E. and Peteraf, M. A. (2003) ‘The dynamic resource-based view: Capability lifecycles’, *Strategic Management Journal*, 24(10 SPEC ISS.), pp. 997–1010. doi: 10.1002/smj.332.

Helfat, C. E. and Raubitschek, R. S. (2000) ‘Product Sequencing : Co-Evolution of Knowledge , Capabilities and Products’, 21(10), pp. 961–979.

Helfat, C. E. and Raubitschek, R. S. (2018) ‘Dynamic and integrative capabilities for profiting from innovation in digital platform-based ecosystems’, *Research Policy*. Elsevier, 47(8), pp. 1391–1399. doi: 10.1016/j.respol.2018.01.019.

Heppelmann, J. E. and Porter, M. (2015) ‘How Smart, Connected Products Are Transforming Companies’, *Harvard Business Review*, pp. 1–38. doi: 10.1017/CBO9781107415324.004.

Hine, D. *et al.* (2013) ‘Deconstructing and reconstructing the capability hierarchy’, 23(5), pp. 1299–1325. doi: 10.1093/icc/dtt046.

Iansiti, M. and Levien, R. (2002) ‘Keystones and Dominators : Framing the Operational Dynamics of Business Ecosystems’.

Johnson, M. W., Christensen, C. M. and Kagermann, H. (2008) ‘Reinventing Your

Business Model', *Harvard business review*, pp. 57–68.

Johnston, H. R. and Carrico, S. R. (1988) 'Developing Capabilities to Use Information Strategically', (March), pp. 37–48.

Joppe, M. (2000) 'The Research Process. Retrieved February 25, 1998'.

Joyce, A. and Paquin, R. L. (2016) 'The triple layered business model canvas: A tool to design more sustainable business models', *Journal of Cleaner Production*. Elsevier Ltd, 135, pp. 1474–1486. doi: 10.1016/j.jclepro.2016.06.067.

Ju, J., Kim, M. S. and Ahn, J. H. (2016) 'Prototyping Business Models for IoT Service', *Procedia Computer Science*. The Author(s), 91(Itqm), pp. 882–890. doi: 10.1016/j.procs.2016.07.106.

Kale, P. and Singh, H. (2007) 'Building Firm Capabilities Through Learning: Capability and Firm-level Alliance Success', 1000(March), pp. 981–1000. doi: 10.1002/smj.

Kamoche, K. (1996) 'Strategic Human Resource Management within a Resource-capability View of the Firm', *Journal of Management Studies*, 33(2), pp. 213–233.

Kiel, D., Arnold, C. and Voigt, K. I. (2017) 'The influence of the Industrial Internet of Things on business models of established manufacturing companies – A business level perspective', *Technovation*. Elsevier Ltd, 68(July), pp. 4–19. doi: 10.1016/j.technovation.2017.09.003.

Kowalkowski, C. *et al.* (2017) 'Industrial Marketing Management Servitization and deservitization : Overview , concepts , and de fi nitions', 60, pp. 4–10. doi: 10.1016/j.indmarman.2016.12.007.

Leminen, S. *et al.* (2018) 'The future of the Internet of Things: toward heterarchical ecosystems and service business models', *Journal of Business and Industrial Marketing*, 33(6), pp. 749–767. doi: 10.1108/JBIM-10-2015-0206.

Leonard-Barton, D. (1992) 'Core Capabilities and Core Rigidities : A Paradox in Managing New Product Development Dororthy Leonard-Barton Strategic Management Journal , Vol . 13 , Special Issue : Strategy Process : Managing Corporate', *Strategic Management Journal*, 13, pp. 111–125.

Levinthal, D. and Myatt, J. (2012) 'Co-evolution of Capabilities and Industry: The Evolution of Mutual Fund Processing', 15, pp. 45–62.

Lozano, L. M., García-cueto, E. and Muñiz, J. (2008) 'Effect of the Number of Response Categories on the Reliability and Validity of Rating Scales', 4(1996), pp. 73–79. doi: 10.1027/1614-2241.4.2.73.

Luz Martín-Peña, M., Díaz-Garrido, E. and Sánchez-López, J. M. (2018) 'The digitalization and servitization of manufacturing: A review on digital business models', *Strategic Change*, 27(2), pp. 91–99. doi: 10.1002/jsc.2184.

Magretta, J. (2002) 'Why Business Models Matter', *Harvard business review*.

Mallery, P. and George, D. (2003) ‘SPSS for Windows step by step: a simple guide and reference’, *Allyn, Bacon, Boston,*.

Manfreda, K. L. *et al.* (2008) ‘Web surveys versus other survey modes: A meta-analysis comparing response rates’, 50(1).

March, S. T. and Smith, G. F. (1995) ‘Design and natural science research on information technology’, 15, pp. 251–266.

Massa, L., Tucci, C. L. and Afuah, A. (2017) ‘A Critical Assessment of Business Model Research’, 11(1), pp. 73–104.

Maurya, A. (2010) *Running Lean*.

Metallo, C. *et al.* (2018) ‘Understanding business model in the Internet of Things industry’, *Technological Forecasting & Social Change*. Elsevier, 136(June 2017), pp. 298–306. doi: 10.1016/j.techfore.2018.01.020.

Mitchell, D. W. and Coles, C. B. (2004) ‘Business model innovation breakthrough moves’.

Möller, K. and Anttila, M. (1979) ‘Marketing Capability — A Key Success Factor in Small Business ?’, (2).

Moore, J. F. (1993) ‘Predators and Prey: A New Ecology of Competition’, *Harvard Business Review*, pp. 75–86.

Moore, J. F. (1996) *The death of competition: leadership and strategy in the age of business ecosystems*. HarperBusiness New York.

Morgan, N. A., Slotegraaf, R. J. and Vorhies, D. W. (2009) ‘Linking Marketing Capabilities with Profit Growth’, (December). doi: 10.1016/j.ijresmar.2009.06.005.

Nalebuff, B. J., Brandenburger, A. and Maulana, A. (1996) *Co-opetition*. HarperCollinsBusiness London.

Normann, R. and Ramirez, R. (1993) ‘Strategy and the Art of Reinventing Value’, *Harvard Business Review*.

Ojasalo, J. and Ojasalo, K. (2018) ‘Service Logic Business Model Canvas’, *Journal of Research in Marketing and Entrepreneurship*. doi: 10.1108/JRME-06-2016-0015.

Osterwalder, A. (2004) *The Business Model Ontology: A Proposition in a Design Science Approach*. Univesite de Lausanne.

Osterwalder, A. and Pigneur, Y. (2002) ‘An e-Business Model Ontology for Modeling e-Business’.

Osterwalder, A. and Pigneur, Y. (2010) *Business Model Generation*, *The Medieval Opus: Imitation, Rewriting, and Transmission in the French Tradition*. doi: 10.1523/JNEUROSCI.0307-10.2010.

Osterwalder, A., Pigneur, Y. and Tucci, C. L. (2005) ‘Clarifying business models: origins, present, and future of the concept', 15(May).

Paiola, M. *et al.* (2013) ‘Moving from products to solutions: Strategic approaches for developing capabilities’, *European Management Journal*. Elsevier Ltd, 31(4), pp. 390–409. doi: 10.1016/j.emj.2012.10.002.

Porter, M. E. (1980) *Competitive Strategy: Techniques for Analyzing Industries and Competitors*. New York: Free Press.

Porter, M. E. (1985) *Competitive Advantage: Creating and Sustaining Superior Performance*. The Free Press.

Porter, M. E. (1991) ‘Towards a Dynamic Theory of Strategy’, 12.

Porter, M. E. (2001) ‘Strategy and the Internet.’, *Harvard Business Review*. Harvard Business School Publication Corp., 79(3), pp. 62–78. Available at: http://search.ebscohost.com/login.aspx?direct=true&AuthType=cookie,ip,uid&db=bsu&AN=4147416&site=ehost-live&scope=site&authtype=sso&custid=s4778523.

Porter, M. E. and Millar, V. E. (1985) ‘How Information Gives You Competitive Advantage’, *Harvard Business Review*. doi: 10.1002/ijc.2910610124.

Prahalad, C. K. and Hamel, G. (1990) ‘The Core Competence of the Corporation’, *Harvard Business Review*, (May-June 1990), p. 15.

Priem, R. L. and Butler, J. E. (2001) ‘Tautology in the Resource-Based View and the Implications of Externally Determined Resource Value : Further Comments’, (January 2014). doi: 10.5465/AMR.2001.4011946.

Raddats, C., Burton, J. and Ashman, R. (2015) ‘Resource configurations for services success in manufacturing companies’, *Journal of Service Management*, 26(1), pp. 97–116. doi: 10.1108/JOSM-12-2012-0278.

Ries, E. (2011) *The lean startup: How today’s entrepreneurs use continuous innovation to create radically successful businesses*. Crown Books.

Rymaszewska, A., Helo, P. and Gunasekaran, A. (2017) ‘IoT powered servitization of manufacturing – an exploratory case study’, *International Journal of Production Economics*. Elsevier B.V., 192(October 2015), pp. 92–105. doi: 10.1016/j.ijpe.2017.02.016.

Saunders, M., Lewis, P. and Thornhill, A. (2009) *Research methods for business students. Essex*, *Financial Times/Prentice Hall*.

Seelos, C. and Mair, J. (2005) ‘Social entrepreneurship : Creating new business models to serve the poor’. doi: 10.1016/j.bushor.2004.11.006.

Silva, E. M. and Maló, P. (2014) ‘IoT Testbed Business Model’, *Advances in Internet of Things*, 04(04), pp. 37–45. doi: 10.4236/ait.2014.44006.

Spender, J.-C. (2014) ‘Making knowledge the basis of a dynamic theory of the firm’, *Strategic Management Journal*, 17(S2), pp. 45–62. doi: 10.1002/smj.4250171106.

Suominen, A., Seppänen, M. and Dedehayir, O. (2019) ‘A bibliometric review on

innovation systems and ecosystems : a research agenda', 22(2), pp. 335–360. doi: 10.1108/EJIM-12-2017-0188.

Tadelis, B. S. (2001) 'Complexity , Flexibility , and the Make-or-Buy Decision', 6072(1937).

Teece, D. J. (1998) 'Capturing Value from Knowledge Assets':, 40, pp. 55–80.

Teece, D. J. (2010) 'Business models, business strategy and innovation', *Long Range Planning*. Elsevier Ltd, 43(2–3), pp. 172–194. doi: 10.1016/j.lrp.2009.07.003.

Teece, D. J., Pisano, G. and Shuen, A. (1997) 'Dynamic Capabilities and Strategic Management', 18(March), pp. 509–533. doi: Doi 10.1002/(Sici)1097-0266(199708)18:7<509::Aid-Smj882>3.0.Co;2-Z.

Tikkanen, H. *et al.* (2005) 'Managerial Cognition , Action and the Business Model of the Firm'.

Valtakoski, A. (2017) 'Industrial Marketing Management Explaining servitization failure and deservitization : A knowledge-based perspective', *Industrial Marketing Management*. Elsevier Inc., 60, pp. 138–150. doi: 10.1016/j.indmarman.2016.04.009.

Weill, P. and Vitale, M. (2001) *Place to space: Migrating to eBusiness Models*. Harvard Business Press.

Wernerfelt, B. (1984) 'A Resource-Based View of the Firm Author (s): Birger Wernerfelt Stable URL : http://www.jstor.org/stable/2486175 REFERENCES Linked references are available on JSTOR for this article : You may need to log in to JSTOR to access the linked references . You', 5(2), pp. 171–180.

Westerlund, M., Leminen, S. and Rajahonka, M. (2014) 'Designing Business Models for the Internet of Things', *Technology Innovation Management Review*, 4(7), pp. 5–14. doi: 10.22215/timreview/807.

Winch, G. M. (2003) 'How innovative is construction? Comparing aggregated data on construction innovation and other sectors – a case of apples and pears', *Construction Management and Economics*. Routledge, 21(6), pp. 651–654. doi: 10.1080/0144619032000113708.

Winter, S. G. (2000) 'The satisfying principle in capability learning', *Strategic Management Journal,* 21, pp. 981–996.

Winter, S. G. (2003) 'Understanding dynamic capabilities', *Strategic Management Journal*, 24(10 SPEC ISS.), pp. 991–995. doi: 10.1002/smj.318.

Wirtz, B. W. *et al.* (2016) 'Business Models: Origin, Development and Future Research Perspectives', *Long Range Planning*, 49(1), pp. 36–54. doi: 10.1016/j.lrp.2015.04.001.

Wise, R. and Baumgartner, P. (1999) 'Go Downstream: The New Profit Imperative in Manufacturing', (October), pp. 133–142.

Wohlin, C. (2014) ‘Guidelines for Snowballing in Systematic Literature Studies and a Replication in Software Engineering’.

Womack, J. P., Jones, D. T. and Roos, D. (2003) ‘The machine that changed the world: the story of lean production. 1991’, *New York: Rawson Associates*.

Yin, R. K. (2017) *Case study research and applications: Design and methods*. Sage publications.

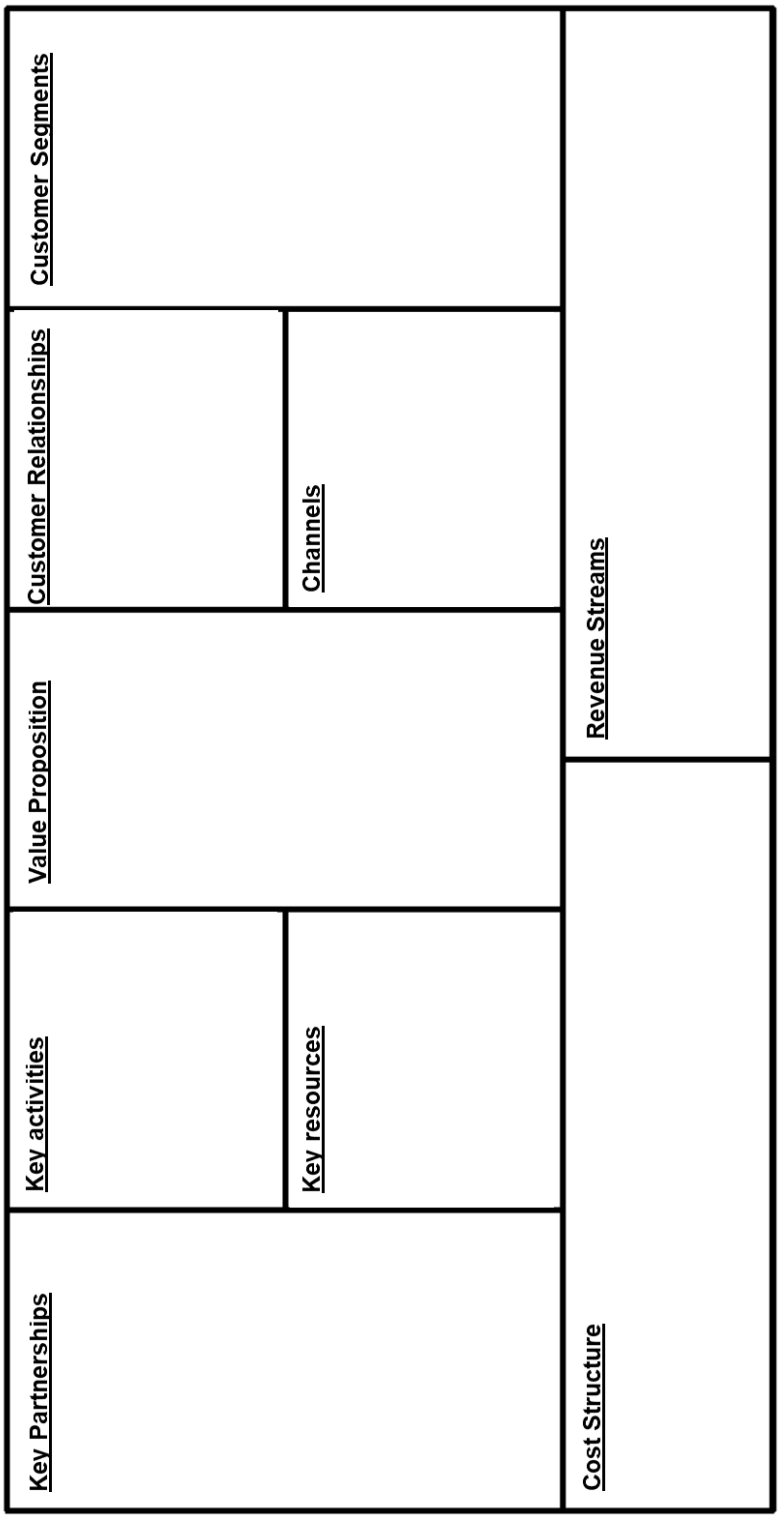
Yip, G. S. (2004) ‘Using strategy to change your business model’, 15(2).

Zahra, S. A. and Nambisan, S. (2012) ‘Entrepreneurship and strategic thinking in business ecosystems’, *Business Horizons*. ‘Kelley School of Business, Indiana University’, 55(3), pp. 219–229. doi: 10.1016/j.bushor.2011.12.004.

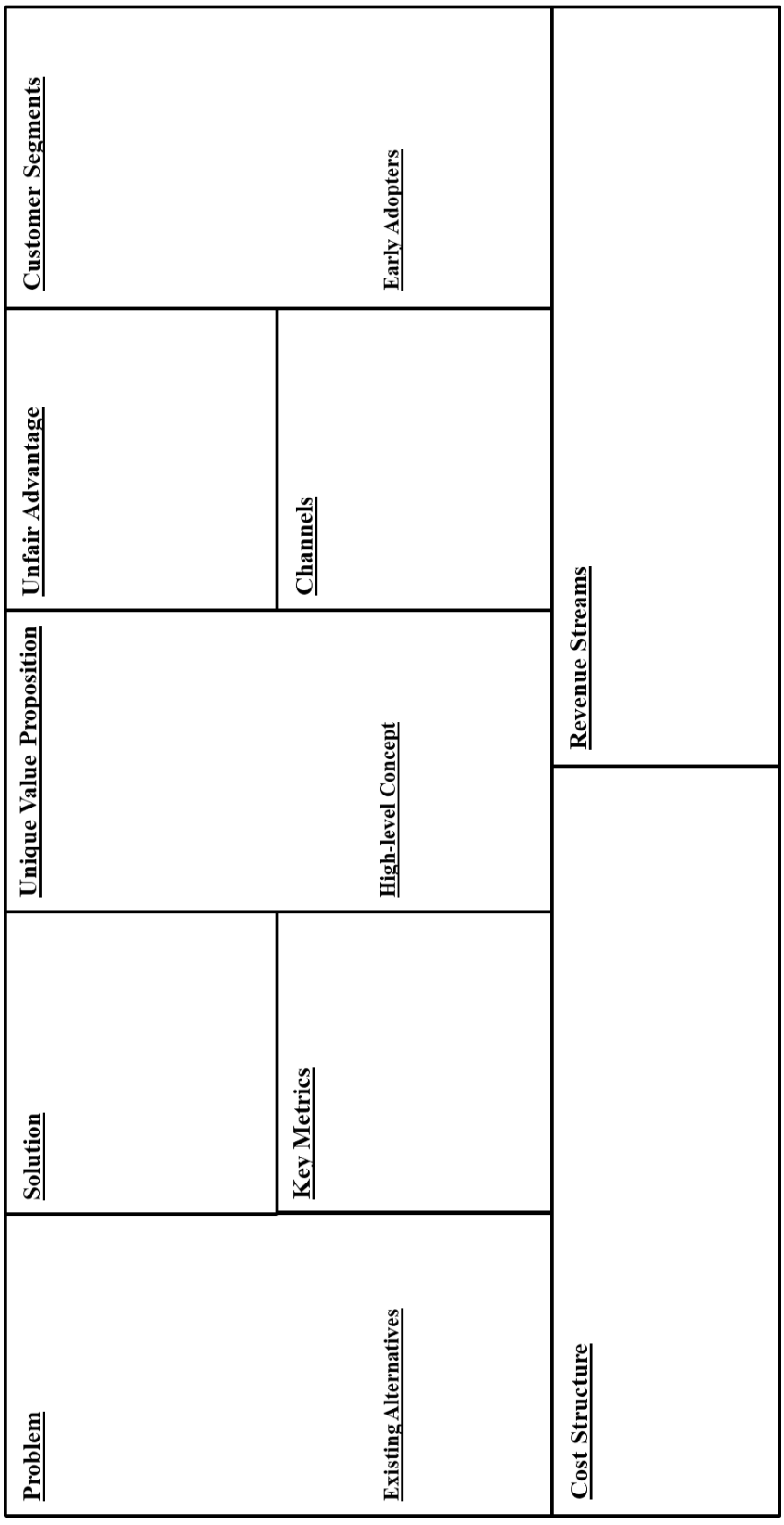
Zolnowski, A., Weiß, C. and Böhmann, T. (2014) ‘Representing service business models with the service business model canvas - The case of a mobile payment service in the retail industry’, *Proceedings of the Annual Hawaii International Conference on System Sciences*, pp. 718–727. doi: 10.1109/HICSS.2014.96.

Zott, C., Amit, R. and Massa, L. (2010) ‘The Business Model: Theoretical roots, recent developments, and future research’, *IESE Research Papers*, 3, pp. 1–43. doi: 10.1177/0149206311406265.

APPENDIX A: THE BUSINESS MODEL CANVAS, FROM OSTERWALDER AND PIGNEUR, 2010.



APPENDIX B: THE LEAN CANVAS, FROM MAURYA, 2010.



APPENDIX C: INTERVIEW STRUCTURE, TRANSLATED FROM FINNISH

Interview structure

Interviewee background questions

- What is your name and current role?
- How would you define your area of expertise?
- Please elaborate on your work history, especially working with ICT systems

On Business model development in the advent of IoT

1. On a general level, how ready are Finnish companies to apply IoT solutions in their business?
2. **How do you see the main focus on business models changing with the advent of IoT?**
    a. **What do you think will be the main focus areas within the Lean Canvas with this development?**
3. **What do you anticipate the change in market dynamics being with connected IoT systems?**
4. **What kind of capabilities would be required for effective utilization of the IoT?**
    a. **Internally?**
    b. **From the partner network?**
    c. **From end customers?**

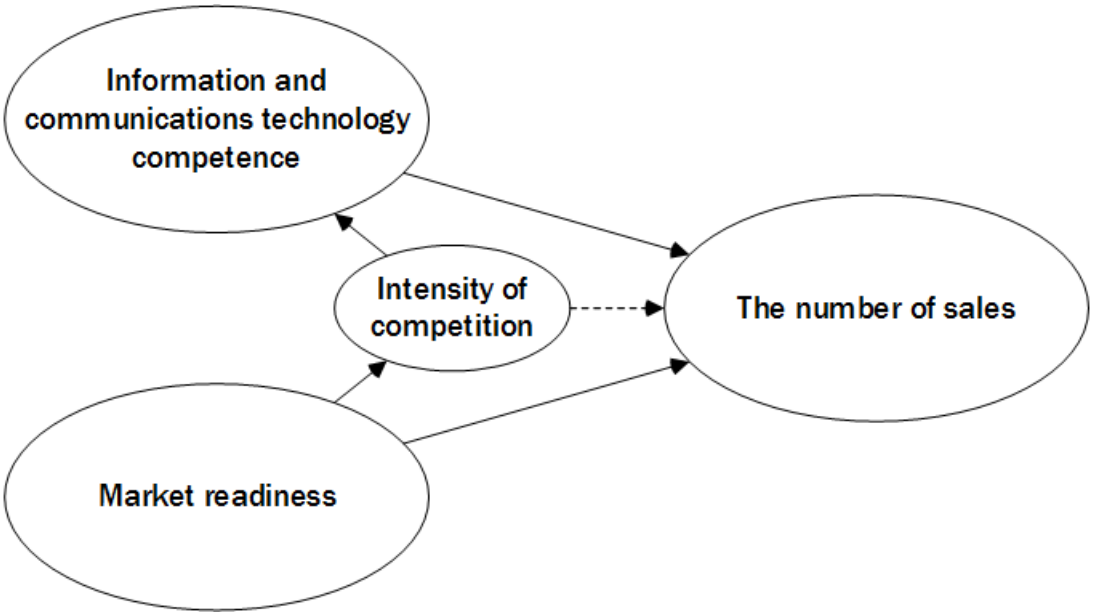
- Have you ever been a part of or monitored projects, where these capabilities were utilized on an excellent level?
    - Please elaborate

IoT and the role of distribution

- How would you characterize the role of distribution in the current business climate in Finland?

5. **What kind of partnerships would bringing IoT solutions to the market in the future require?**
6. **How do you think the role of distribution will change with the advent of IoT solutions?**
7. **How do you perceive the value proposition of distributors changing in the future?**
    a. **Would you see the value proposition extending to previously non-covered areas? How would this development take place particularly in the Finnish market?**
8. **IoT, with more embedded solutions, will require a higher level of ICT capabilities from manufacturers, do you think this will also be the case with distributors?**
9. **Do you think that the issue of customer ownership will gain more focus with IoT?**

APPENDIX D: FRAMEWORK FOR ANALYSIS OF SURVEY DATA



APPENDIX E: SURVEY STRUCTURE, TRANSLATED FROM FINNISH

Survey frame

Respondent background questions

- Are you familiar with the following appliances (shown as pictures)? Select appliances you are familiar with
- How many employees work at your location (referring to an office or a storefront)? Choose most applicable
    a. Less than 5 employees
    b. 5 to 10 employees
    c. More than 10 employees
- How many employees work for your firm? Choose most applicable
    a. Less than 10 employees
    b. 10 to 25 employees
    c. More than 25 employees
- How long has it been since your previous installation of an IoT-based industry product? Choose most applicable
    a. Less than a week
    b. 1 to 4 weeks
    c. 4 weeks to 3 months
    d. More than 3 months
    e. We haven't installed

ICT Competence

Choose an answer that best reflects your opinion (1 = Strongly disagree, 2 = Somewhat disagree, 3 = Somewhat agree, 4 = Strongly Agree)

1. ICT capabilities will play a significant role in the future in installing industry products.
2. Internally, I feel like we have the required knowhow necessary for delivering Internet of Things solutions to customers.
3. Our goal is to expand our service offering in the following 5 years.
4. To avoid future challenges, we continuously develop our ICT capabilities.IoT and the role of the distribution

Market readiness

Choose an answer that best reflects your opinion (1 = Strongly disagree, 2 = Somewhat disagree, 3 = Somewhat agree, 4 = Strongly Agree)

5. Customers wish for more comprehensive security solutions, in comparison to what was previously available.
6. Internet of Things solutions offer increased value to end customers.
7. Customer needs develop faster than the customer value that can be offered with the current product lineup.

8. End customers wish for additional services around the basic installation of an industry product.

Intensity of competition

Choose an answer that best reflects your opinion (1 = Strongly disagree, 2 = Somewhat disagree, 3 = Somewhat agree, 4 = Strongly Agree)

9. There is considerable amount of competition in delivering Internet of Things solutions to customers.
10. Our competing companies are larger than our company.
11. Our competitors have better resources for delivering Internet of Things solutions than we do.
12. I feel like our ICT capabilities are on par with our competition.